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NORTH AMERICAN SOCIAL REPORT

A Comparative Study of the Quality of Life in Canada and the USA from 1964 to 1974

by

ALEX C. MICHALOS
University of Guelph, Ontario, Canada

Volume Four

Environment, Transportation, and Housing

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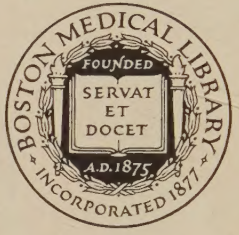

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Chapter 2. Population Structure
Chapter 3. Death, Disease and Health Care

Volume II: *Crime, Justice, and Politics*

Chapter 4. Crime and Justice
Chapter 5. Politics and Organizations

Volume III: *Science, Education, and Recreation*

Chapter 6. Science and Technology
Chapter 7. Education
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Volume IV: *Environment, Transportation, and Housing*

Chapter 9. Natural Environment and Resources
Chapter 10. Transportation and Communication
Chapter 11. Housing

Volume V: *Economics, Religion, and Morality*

Chapter 12. Economics
Chapter 13. Religion
Chapter 14. Morality and Social Customs
Chapter 15. Conclusion

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With love,
To Deborah,
who has improved
the quality of my life

PREFACE

For readers who intend to read this volume without reading the first, some introductory remarks are in order about the scope of the work and the strategy used in all five volumes to measure the quality of life. In the first chapter of Volume I, I reviewed the relevant recent literature on social indicators and social reporting, and explained all the general difficulties involved in such work. It would be redundant to repeat that discussion here, but there are some fundamental points that are worth mentioning. Readers who find this account too brief should consult the longer discussion.

The basic question that will be answered in this work is this: Is there a difference in the quality of life in Canada and the United States of America, and if so, in which country is it better? Alternatively, one could put the question thus: If one individual were randomly selected out of Canada and another out of the United States, would there be important qualitative differences, and if so, which one would probably be better off? To simplify matters, I often use the terms 'Canadian' and 'American' as abbreviations for 'a randomly selected resident' of Canada or the United States, respectively.

The time frame selected for analysis is roughly the decade from 1964 to 1974. Within this decade, the smallest time frame considered is a year long, because most of the statistics used appear on a yearly basis. The smallest spatial frames used are typically the whole countries. When material is drawn from national opinion polls, usually Alaska and Hawaii are omitted from the USA and the Yukon and Northwest Territories are omitted from Canada. Although more precise comparisons could have been drawn if smaller spatial frames had been selected (e.g., regions, counties, Standard Metropolitan Areas, etc.), each additional cut would expand the treatise and contract the data base. For these and other reasons no smaller frames were selected.

Given these broad parameters of time and space, the next step was the selection of appropriate areas of concern. The following thirteen were selected, largely on the basis of the availability of data in each area and a general consensus that has been emerging in the literature: population; death, disease and health care; housing; crime and justice; leisure activities; transportation and communication; education; science and technology; government and

organizations; natural environment and resources; economics; religion; morality and social customs.

In each of the thirteen areas of concern, statistical measures called 'social indicators' are identified. Some of these measures involve publicly observable things like births and deaths, immigrants, automobiles and national parks. Others involve personal experiences like happiness, satisfaction, preference and belief. The former sorts of indicators are usually referred to as 'objective' and the latter are called 'subjective'. Social indicators are divisible into three broad classes. First, there will be *positive indicators* which are such that most people will assume that if their indicator-values increase, some facet of the quality of life is improving, e.g., elderly citizens' incomes and minority-group educational attainment. Second, there will be *negative indicators* which are such that most people will assume that if their indicator-values increase, some facet of the quality of life is deteriorating, e.g., infant mortality rates and murder rates. (Notice that an indicator is here regarded as positive or negative not in virtue of whether or not its values in fact increase or decrease, but only in virtue of whether or not one would like its values to increase or decrease, i.e., not in virtue of the *fact* but in virtue of the *desirability* of an increase or decrease in its values.) Third, there will be *indicators* which are regarded as *unclear* because either (a) most people will not be willing or able to say whether bigger indicator-values indicate a better or worse state of affairs, or (b) there is serious disagreement about whether bigger indicator-values indicate a better or worse state of affairs. In the case of welfare payments, for example, people do not know what to say because as the values increase there may be an increase of people in need of such assistance, which is bad; while, at the same time, there is an increase in the amount of assistance given, which is good. In the case of divorce rates, on the other hand, many people know exactly what they want to say, and they happen to disagree with what some other people want to say.

So far as positive and negative indicators are concerned, the preferred or preferable direction of movement of indicator-values is determined. It is precisely the determination of the direction in which the indicator-values ought to be moving (which is here identified with the direction in which most people, given my information, would prefer them to move) that classifies an indicator as positive or negative.

I refer to the upward or downward movement of an indicator-value as its 'flow-value' or 'flow' for short, and contrast this with its value at any point in time, which I call its 'stock-value' or 'stock' for short. For example, an annual infant mortality rate per 1000 live births may have a stock-value of 25 for

one year and 10% increase or flow-value from that year to the next. Since it is generally agreed that the lower the infant mortality rate, the better, an increase of 10% would mean some deterioration has occurred, i.e., so far as this one indicator is concerned, we would not be as well-off as we were.

I measure the *comparative* or *relative* quality of life in the evaluative sense in Canada and the United States as follows. Every pair of stock-values for every positive or negative indicator and every pair of flow-values is examined. Then:

(1) Score one point per year for every year to the country whose stock-value is preferable.

(2) Score one point per year for every year to the country whose flow-value (annual percent change) is preferable.

(3) Sum the points to obtain a final score for each country for all indicators.

(4) The final scores are measures of the comparative or relative quality of life in each country, and the country with the highest score has the highest quality of life.

The meaning of these scores should be clear. For example, because Canada's violent crime rate for 1964 is lower than that of the United States, Canada gets one point. Because Canada's violent crime rate grew more slowly than that of the United States from 1964 to 1965, Canada gets another point. If the stock or flow-values for both countries had been the same, no points would have been awarded. Although the scarcity of subjective indicators occasionally requires some other modifications of our procedure, basically this is how it works for (1) and (2). The other modifications will be explained whenever they occur.

According to (3) and (4), all the points are added for each country and the results are then inspected. For example, suppose the score for all our indicators is 1200 for Canada and 900 for the United States. That means that looking at well over 2100 matched pairs of stock and flow indicator-values and repeatedly asking the question "Is Canada or the United States better off with respect to these two values?", 1200 times the answer is 'Canada' and 900 times 'United States'. Nothing could be much simpler than that.

Simplicity is one thing; simplemindedness another. Several questions about this strategy demand attention before we proceed. First: Is it misleading or incorrect to refer to this strategy as a method of *measuring* the relative quality of life in the two countries? Insofar as it is correct to say that one can measure the case load of a social worker by counting his cases, the output of a poet by counting his poems and the population of a city by counting its

inhabitants, there is nothing peculiar about the idea of measuring the quality of life by counting simple comparative judgments. One might object that the method does not produce reliable or valid measurements, but that is a different problem.

Is the strategy reliable and valid? I can't prove that it is. I know that its reliability and validity are empirically testable, and *that* may be a shock to some people. If one adopts my view of the ontological status of values, (explained in Volume I, Chapter 1) then the reliability and validity of the method can be tested with surveys or any other acceptable fact-finding technique. The process would be similar to that used in the early days of the Stanford-Binet intelligence test. With Stanford-Binet the question was: Does the test rank-order pupils roughly the same way their teachers rank-order them according to brightness? For us the question is: Does my assessment of the comparative quality of life in Canada and the United States roughly match that of most other people? In an important sense I'm betting about ten working years of my life that the answer to that question is affirmative. That's not a demonstration of the reliability and validity of the method, but it's not an entirely irrelevant consideration either.

A third important question concerns the implicit equal weighting of all indicators. Insofar as I regard every judgment of the form "*x* is better off than *y* with respect to the pair of indicator-values *zz*" as worth just as much as every other similar judgment, I am implicitly treating all indicators as if they were equally important. For example, if Canada makes a point for having a lower crude death rate than the United States some year and the United States makes a point for having a greater proportion of households with television sets, then (roughly speaking) the possession of television sets is being equated to human mortality. Put another way, any number of deaths can be swapped for some number of television sets, and vice-versa. Economists would say I have assumed the continuous substitutability of all commodities, and that is highly dubious given the range of 'commodities' under consideration, e.g., human deaths and television sets. So: Are there good reasons for assigning all indicators the same weight?

I certainly do not believe that one can put a plausible price on everything, especially human life. All of my attempts to assign utilities to deaths in any form (e.g., suicides, murders, infant deaths, etc.) have been unsatisfactory. For a while I worked with two sets of indicators, one related to deaths and the other including everything else. Then I discovered that Canada was practically always better off on the death indicators. So if the two sets were combined, the general assessment would be biased in favour of the United

States. That is, because the indicator-values of Canada's death-related indicators are typically better than those of the USA, putting all indicators in the same index has the effect of allowing very important favourable Canadian points to be treated as equal to relatively much less important favourable American points. I have accepted this anomaly because I know of no good way to avoid it and because the bias is in the American direction. The latter reason may trouble my neighbours, but since many people will probably assume I'm out to vindicate my own preference for Canada, here and in other places I explicitly tip the scales in favour of the USA.

The problem of continuous substitutability of things like TV sets, bankruptcies, cases of venereal disease and so on remains serious even when death-related indicators are set aside. To make a long story short, let me just admit that some of the trade-offs look farfetched and some don't. Again, however, I know of no good way to assign individual weights, utilities or values to the diverse items considered. Put positively, every weighting scheme I have considered using demands so many assumptions about the items in question that the resulting weights would be no more reliable and valid than the blanket assumption of equal weights for everything. So, I made the blanket assumption.

A fourth question that arises about my measuring device concerns the assumption that any amount of increase in the indicator-values of positive indicators or decrease in the indicator-values of negative indicators is an improvement. Insofar as any quantity (including any series or function) may only increase or stay the same but never decrease, it is said to be a 'monotonic increasing quantity'. Similarly, quantities which only decrease or stay the same are called 'monotonic decreasing quantities'. Thus, positive and negative indicators are here assumed to behave like monotonic increasing and decreasing series, respectively. In fact, of course, the good or evil attached to similar indicator-values for different indicators does not just rise or fall regularly as it would if the condition of monotonicity were satisfied. If more women became physicians, it would probably be better for most of us, but not if *only* women became physicians. A smaller defence budget would be nice; a zero-sized defence budget would be dangerous. In view of cases like these, are there good reasons to adopt the strategy followed here?

There are several reasons for taking the line I have taken. The first is ignorance of how to take a finer line. For many of the indicators considered here, no one knows when enough is enough. For example, is six the optimum number of visits to a park for any individual in one year, or is it ten or what? When are we importing too much from a single country? Questions like these

do not seem to admit of short, easily discernible answers. Besides, even if we could decide, say, how many park visits were just enough for most people, we don't have unduplicated counts of such visits. We don't know if one man is going in and out of Yellowstone every day, or if seven people are visiting the park one time each. Often we don't know if people admitted to prisons or hospitals come off the streets or out of some other prisons or hospitals. We count persons charged with crimes, but we don't know if one person is very busy and unlucky or if several people are engaged in criminal activity at a fairly leisurely pace with tremendous success. In view of such ignorance, there seems to be little point in wondering about the problems of peak performance and whether or not we may have turned the corner in some area.

Another reason for taking the line I have taken with respect to the assumption of monotonicity is that most of the stock and flow-values we have seem to be in a decidable range. That is, for the great majority of cases there does not seem to be any danger of being led astray by this assumption. One could surely question whether enough households already have one or more automobiles or television sets, or something else, but one would be hardpressed to substantiate the case. Usually it would crumble in the face of insufficient evidence concerning duplicated counts, distribution by geographic area or class, real goods and evils involved, and so on. On the other hand, few people will be reluctant to grant that a few more female physicians, a few less violent crimes, fewer suicides, etc. are all to the good, and there are many more cases like these than the others. Accordingly, the assumption of monotonicity seems to be quite innocuous here.

A fifth important question is this: Isn't it possible for one of the two countries to be much better off than the other but for both to be very bad or well off? Absolutely. A relative measure does not produce absolute measurements; being better off than one's neighbour is not equivalent to being generally well off.

It is perhaps worthwhile to mention in this context that I do make independent assessments for each country of its progress from the first to the last stock value for every one of our social indicators. Although these assessments are not comparative judgments with respect to the other country, they are still comparative with respect to the 1964 baseline or some year close to it. In this work there is just no escape from and nothing superior to comparative evaluations.

Sixth, one might wonder if it is reasonable to count stock and flow values as equally important. Flow values give one an idea of the rate of change of

indicator-values, while stock values only capture a static view. In business, where these notions originated, it is well-known that flows are every bit as important as stocks, and that one can be traded off against the other with good or bad consequences. Similarly, various rates of change are known to have healthy or debilitating effects on living organisms, just as various levels of available supplies do, e.g., food, oxygen, sunlight, etc. These considerations led me to treat stock and flow values as equally important.

Finally, I think I should say that I have no illusions about being able to satisfy everyone with the arguments put forward in defense of all the judgments made in this work. The work is explicitly evaluative and occasionally polemical, and there is nothing inherently unreasonable about such a project. Reasonableness does not require one to be right or even agreeable all the time. It only requires one to think critically, especially about one's own judgments. I have tried to do that in this work and I invite others to do the same.

I owe special thanks to Sandra Howlett who has had the tiresome task of typing this long manuscript.

Guelph, January 1981 ALEX C. MICHALOS

CHAPTER 9

NATURAL ENVIRONMENT AND RESOURCES

"Continue to contaminate your bed, and you will one night suffocate in your own waste . . . "

Chief Seattle,
Leader of the Suquamish tribe,
Washington Territory

1. INTRODUCTION

Nearly a thousand years ago St. Thomas Aquinas argued that angels could not eat.[1] If they ate, he thought, they would either produce waste or become infinitely large. The latter seemed absurd and the former was incompatible with his idea of perfect beings. Apparently St. Thomas didn't consider the possibility that angels might be perfectly efficient, converting all their food to useful energy of some sort.

Ordinary mortals, of course, are not perfect. They naturally produce waste, but they need not produce as much waste as they do. Indeed, they better not. That is the fundamental underlying message in this chapter, to which we return again and again from a variety of different perspectives.

The chapter opens with a summary of some basic ecological principles and laws (Section 2), followed by an analysis of the idea of a resource and the role of human ingenuity in the identification of resources and reserves (3). The remaining 20 sections may be subdivided into four sets and a chapter summary (23). The first substantive set consists of Sections 4 to 12, and is devoted to energy production and consumption in several forms. An aggregated measure of energy is introduced in Section 4, followed by a review of some literature concerning the control of energy production (5). Section 6 contains a discussion of electricity production and use in North America.

One of the most important problems faced by people in all developed countries is the assessment of the risk or potential hazards associated with the use of diverse types of fuels. Section 7 presents some of the general difficulties of risk assessment. Then there are five sections reviewing the production and consumption figures for and some of the advantages and disadvantages of using nuclear fission (8), oil (9), natural gas (10), coal (11), and several other energy sources (12).

The second substantive set consists of Sections 13 to 17, and is devoted to materials production and consumption in several forms. The main difference between the materials discussed in Sections 4 to 12 and the materials discussed in Sections 13 to 17 is that the former typically provide the energy to make things out of the latter. Section 13 presents a longer account of the difference. Then there are three sections reviewing production and consumption or export and import figures for selected metals (14), chemicals (15) and forest products (16). Land use did not lend itself to a similar sort of analysis, but its story is told in Section 17.

The third substantive set consists of Sections 18 to 21, and is devoted to environmental degradation in several forms. Section 18 provides some background information about environmentalism and pollution. In Section 19 some indicators of air pollution are introduced. The discussion of water (20) focuses on problems related to the irresponsible manipulation of waterways, and the wildlife section (21) concerns endangered or threatened species, and fur trade.

The fourth substantive set has a single section (22) on conservation. Conservation was mentioned several times in earlier sections, but it merits special attention as the most reasonable way to attack most of our problems with natural resources and environmental degradation.

As usual, the final section (23) summarizes the results of the chapter and combines them with the results of earlier chapters. There is an assessment of the comparative quality of life in Canada and the United States with respect to the area of natural resources and the environment, and collectively with respect to all the areas of concern considered so far.

2. ECOLOGY

Ecology is the study of the "relationships and the processes linking each living thing to the physical and chemical environment."[2] The word itself is a direct descendent from 'oekologie', which was introduced in 1866 by Ernest Haeckel in a book on animal morphology.[3] Its Greek roots are 'oikos' meaning house, and 'logos' meaning discourse. It represents, as one author said, "an appropriate designation for the study of the biosphere in which we live."[4]

The general intellectual roots of ecology may be traced at least as far as Anaxagoras of Klazomene around 430 B. C. Anaxagoras was "the first to introduce the teleological principle into the explanation of the natural world."[5] The world was not merely a whirling mass of simple substances

existing without form or purpose, but a harmoniously ordered system of such substances. It was, he thought, "really the good and the beautiful which joins, forms and maintains the world."[6] Whatever he meant by "the good and the beautiful," it's fairly certain that he saw the world as reasonably ordered. It was a world designed by something or other in the interest of goodness and beauty. At least one author has explicitly placed this view at the very core of ecology. "I am convined" Glacken wrote, "that modern ecological theory, so important in our attitudes toward nature and man's interference with it, owes its origin to the design argument. The wisdom of the creator is self-evident, everything in the creation is interrelated, no living thing is useless, and all are related to one another."[7]

While the roots of ecology are ancient, it became practically everybody's business in the decade of our investigation. In 1970 North Americans celebrated Earth Day.[8] In 1972 an estimated 300 books on ecology, the environment and pollution were published in the United States.[9] The following definition of an "ecosystem" (written in 1969) provides a remarkable summary of the connected set of concerns that will occupy our attention in this chapter. Odum defined an ecosystem as

" . . . a unit of *biological organization* made up of all of the organisms in a given area (that is, "community") interacting with the *physical environment* so that a flow of *energy* leads to characteristic trophic structure and *material* cycles within the system."[10] (Emphasis added)

The U.S. National Commission on Materials Policy made the connections even clearer four years later.

"The material resources and environmental quality of the Nation are affected by a lack of consideration of the two as a unit. Depletion of reserves and pollution have the same cause – failure to manage the flow of materials as a cycle, resulting in a resource depleting dispersal of energy and materials into the environment as pollutants. A national policy for the management of energy and materials is needed to transform this open-ended process of wastage into a substantially closed system."[11]

In spite of the abundance of relatively reliable information about biology, physics and chemistry (compared to information about, say, psychology, sociology and politics), there is general agreement that there are serious deficiencies in our knowledge of ecosystems. According to Westman and Conn,

"We are at a stage in our knowledge . . . where few persons understand the full implications of ecosystem functioning, and there are numerous aspects of ecosystem functioning which are fully understood by no one."[12]

In the best review of ecological theory I found, McIntosh claimed that

" . . . one of the difficulties in assessing the state of modern theoretical ecology is that there are several disparate bodies of theoretical ecology stemming from roots in pre-ecology and early formal ecology which are not well integrated with each other. This is exacerbated by the fact that there are substantial differences in philosophy between different groups of theoretical ecologists. These are sometimes seen as the differences between those who adopt a reductionist, analytic, population-centered view of ecology and those who adopt a holistic, ecosystem-centered view of ecology."[13]

A report of the Organization for Economic Co-operation and Development (OECD) indicated that there was an "absence of a model generally accepted by Member countries, for the assessment of interactions between human activity and the environment."[14]

The most frequently mentioned law of ecology is the rather folksy "Nature knows best." Commoner calls this "The third law of ecology", the others being "Everything must go somewhere", "Everything is connected to everything else", and "There is no such thing as a free lunch."[15] Of course Commoner was not writing hard-nosed science for scientists when he formulated those laws, but he was not writing science fiction either. His folksy generalizations capture more cautious scientific hypotheses that are broadly accepted among ecologists. Nevertheless, "broadly accepted" does not mean uncontroversial.

Even the fundamental principle that "Nature always, so to speak, knows where and when to stop . . . . [and] . . . tends to be self-balancing, self-adjusting, self-cleansing"[16] is not without dissent. Dubos has characterized it as bordering between the trivially true and the patently false, which hardly makes it unique in the class of alleged laws of nature.[17] "Under equilibrium conditions", he wrote, "the wastes of nature are constantly being recycled in the ecosystem, which becomes thereby more or less self-perpetuating."[18] But the fact that a system is "self-perpetuating" doesn't mean that it's good for anything but self-perpetuation. Moreover, there are usually several ways for a given system to arrive at a state of equilibrium, some of which are more attractive or desirable for human interests than others. In a mood that might have made old Anaxagoras sit up in his grave, Dubos claimed that

"What is surprising is not that the natural environments are self-sustaining and generally appear efficient but, rather, that many of them constitute clumsy solutions to ecological problems. Many of these solutions appear inadequate, even where nature has not been disturbed by man or by cataclysms, and therefore could have been expected to reach the optimum ecological state."[19]

Examples of "clumsy solutions to ecological problems" include population

crashes among lemmings, muskrats and rabbits, which control population sizes at the expense of "unquestionably ... traumatic experiences for the animals."[20] Incomplete recycling of organic matter has left vast deposits of peat, coal, oil and shale. By burning peat, coal and oil people tend to complete the recycling processes by making "the carbon and minerals of these fuels once more available for plant growth."[21] Indeed, Dubos persuasively argues that human action is capable of producing much greater benefits than the mere completion of natural processes. Nature, he claims,

" ... is incapable, by itself, of fully expressing the diversified potentialities of the earth. Many richnesses of nature are brought to light only in the regions that have been humanized: agricultural lands, gardens, and parks have to be created and maintained by human toil."[22]

In the presence of limited information and serious theoretical disagreements about the structure and functioning of ecosystems, it is to be expected that there are equally serious disagreements about what happens next and what should be done now.[23] As one might also expect, people tend to be polarized around basically optimistic or pessimistic views. An excellent review of these two groups has been written by Sills, contrasting their "views of man, society, nature, and economic growth."[24] Generally speaking, the people Sills calls "environmentalists" are pessimistic, and the optimistic people are described as their "critics".[25] Pessimists or "environmentalists" tend to believe that

" ... the supply of natural resources is not only finite but is also being used up much too rapidly; that in spite of the so-called Green Revolution food shortages and famines will be commonplace in the coming decades; that pollution is largely a product of modern industrial society and is generally getting worse, to the point where the world will be nearly unlivable before long; and that all of these problems are compounded by exponential population growth."[26]

Pessimists tend to view people and societies as severely limited managers of their own lives and everything else. In the shortsighted pursuit of their own interests narrowly conceived, people become victims of the "tragedy of the commons."[27] That is, the pursuit of individual interests narrowly conceived will lead to collective self-destruction. Even the pursuit of an ever-expanding economy (which in principle would allow everyone to have a bigger share of whatever pie there is) is viewed as self-destructive. The apparently bigger "pie" of goods and services available to North Americans can only be purchased at the cost of continued degradation of the environment and the lives of people in less developed countries.[28]

Optimistic critics of these views cover a variety of positions, from those who tend to pooh pooh the whole pessimistic package to those who take at least some parts of the pessimistic diagnosis very seriously while rejecting most of their prognoses.[29] Since, as it will become clear as this discussion proceeds, there is a considerable amount of reliable knowledge behind parts of the pessimistic diagnosis, it would be a mistake to dismiss the whole package out of hand. However, as I have said before in this work, about all that follows from total pessimism is psychological depression and despair, and there's not much future in that. So, I think wisdom is clearly on the side of the cautious optimists. The following summary statement by Commoner admirably describes the sorts of adaptations that will be required to avoid the pessimists' predicted catastrophes.

"If we are to survive economically as well as biologically, industry, agriculture, and transportation will have to meet the inescapable demands of the ecosystem. This will require the development of major new technologies, including: systems to return sewage and garbage directly to the soil; the replacement of many synthetic materials by natural ones; the reversal of the prsent trend to retire land from cultivation and to elevate the yield per acre by heavy fertilization; replacement of synthetic pesticides, as rapidly as possible, by biological ones; the discouragement of power-consuming industries; the development of land transport that operates with maximal fuel efficiency at low combustion temperatures and with minimal land use; essentially complete containment and reclamation of wastes from combustion processes, smelting, and chemical operations (smokestacks must become rarities); essentially complete recycling of all reusable metal, glass, and paper products; ecologically sound planning to govern land use including urban areas."[30]

3. RESOURCES

In the preceding section it was noted that pessimists claim that the cost of an expanding North American economy at its present rate would be increasing impoverishment abroad and pollution at home. The most frequently cited facts pertaining to this claim are that the United States has only about 6 percent of the world's population, consumes over 40 percent of the world's resources and produces nearly half of the world's pollution.[31] Table 1 (T1) summarizes the world situation in the early 70's concerning so-called nonrenewable resources. (Hereafter 'Table' is abbreviated by T, 'Figure' by F, and 'Chart' by C. Tables, figures and charts are at the end of each chapter. When data are not available for some years, either a blank space is left in the table or NA is inserted.) Granted that such figures are more "guesstimated" than estimated, they do seem to be widely accepted.

Throughout this chapter, as elsewhere in this book, I will make a special effort to reveal the foundations and limitations of such figures, concentrating mainly of course on Canadian and American data.

In an earlier work I defined a resource as something that "can be brought to bear constructively on some feature of a decision situation by a decision-maker."[32] In that work I was primarily concerned with sharpening the conceptual tools that people use to think about decision-making as a kind of basic human action. I thought and still think that people should not think merely of material goods when they think of resources. Virtually anything could be a resource, including " . . . money, a moral rule, a physical event, a person, a procedure, a psychological quirk, and so on."[33] This broad view of the idea of a resource has the important implication that using resources is *not* always tantamount to *using them up.*[34] Moral rules and social customs, for example, are strengthened with use. Their force or influence on a community is not depleted with use. Since, as in Chapter Three (on death, disease and health care), lifestyles have a dominant impact on the quality of our lives, they should be regarded as resources. Lifestyles are in principle among our most manageable resources. How we shop, dress, eat, travel, entertain and house ourselves, for examples, are matters over which we have relatively significant control. The wise control of such matters is nothing more or less than the wise management of resources.

Most of the statistical information presented in this chapter concerns physical resources, e.g., minerals for energy and manufacturing. Frequently in this area the term 'resource' is used to refer to all accumulations of mineral deposits that are "known *or* inferred to exist."[35] The subset of these deposits that is actually known, rather than merely inferred, to exist is often referred to as a 'reserve'. Thus, for example, the list of known global reserves in the second column of T1 refers to minerals known to be obtainable by conventional methods. Since, in this area, even the things that are known to exist involve substantial inferences, I will not scrupulously adhere to these distinctions. The other fairly popular distinction that I will not take too seriously concerns renewable and nonrenewable resources. In this respect I am following Brooks and Andrews. "There are" they wrote, "examples of such presumably renewable resources as fish and timber that have been totally exhausted, while presumably nonrenewable resources like minerals seem to be producible almost without end. In fact, analysts who have reviewed the issue carefully have not found many conceptual differences among natural resources on the basis of their renewability."[36]

There is some controversy over just what it means to be "obtainable by

conventional methods." Clearly it has something to do with what it is possible to obtain by conventional methods. Unfortunately, as I explained in my earlier book, possibilities come in many flavours.[37] Minerals that are, for example, technologically possible to mine, may be economically or politically beyond reach. It is technologically possible to extract oil from shale, but economically impossible, i.e., it violates principles of sound economic investment.[38] The impossibility of Americans getting oil from Iran is only political. It is technologically possible to obtain Iranian oil.

When the Department of Energy, Mines and Resources issued its report on *Oil and Natural Gas Resources of Canada 1976*, it asserted that "The estimates in this report are not constrained by economic considerations other than the stipulation that the oil and natural gas is technically recoverable from the reservoir."[39] It looks as if the authors of the report intended to say that as long as there was *some* price at which it would be "technically" possible to recover oil and gas from some reservoir, they would regard the minerals as obtainable. In other words, they intended to make estimates that were practically independent of any economic considerations, or more precisely, of any price. That sort of exercise strikes some folks, including me, as misleading at best. It suggests, contrary to both ecology and economics, that there may be a practically free lunch. It assumes that the idea of a mineral reserve is practically independent of anyone's ideas about what to do with the reserve, at what cost, for what purposes and so on. But these assumptions are undermined by history and contemporary science.

Historically, for example, Sills reported that

"Except in China, coal was not considered a valuable natural resource until the seventeenth century. For example, the *Domesday Book* of 1085–1086, the record of the great survey of England carried out for William the Conqueror, which purported to list everything of value in the country, makes no mention of coal as a resource. Electricity was potentially abundant, but was not considered a source of energy until the eighteenth century. Petroleum had only medical and magical uses until the nineteenth century, and uranium was unimportant until the 1940's. . . . 'The origins of natural resources,' says William Burch, 'are to be found in society, not in the earth . . . . ' "[40]

Boyd made the connection between resources (usable materials) and human institutions as follows:

"Throughout human history increasing numbers of substances have been discovered and more specialized needs have developed. These materials require reduction into useful states; they require mining or harvesting, concentrating, smelting, processing or refining, alloying or compositing, and fabricating before they become useful to society. Thus, sophisticated materials usage has mandated the formation of equally sophisticated

human institutions; such an evolution formed the basis for the individual revolution, which is still occurring."[41]

Excellent reviews have been written by Westman[42] and by Westman and Conn[43] concerning recent work on identifying the benefits obtainable from the functions of ecosystems. From the beginning of recorded history people have recognized *structural* features of their environments as resources. For example, animals and plants have been eaten, stones and forest products have been used to make tools, houses and various kinds of vehicles. But the *dynamic* or *functional* features of their environments have received relatively little attention. However,

"These functions impart to society a variety of benefits. They include the absorption and breakdown of pollutants, the cycling of nutrients, the binding of soil, the degradation of organic waste, the maintenance of a balance of gases in the air, the regulation of radiation balance and climate, and the fixation of solar energy – the functions, in short, that maintain clear air, pure water, a green earth, and a balance of creatures; the functions that enable humans to obtain the food, fiber, energy and other material needs for survival."[44]

Since most people are unaware of the benefits they receive from ecosystem functions, they do not regard the latter as resources. So ecosystem functions are typically undervalued. They are especially undervalued by the standard economic practice of identifying the cost of a damaged system with the cost of repairing it. In Westman's words,

"Attempts to estimate the benefits of reducing damage to ecosystem functioning by estimating the costs of repairing or replacing damaged functions have limited applicability. One could argue that such an approach could be implemented by estimating the costs of rehabilitating cleared vegetation, the costs of air-conditioning buildings in an urban heat island, the costs of dredging sediment from basins, and the costs of treating aquatic wastes. In practice, however, we rarely repair all the damage (for example, who pays to restore earthworn populations decimated by erosion?), and in many instances, we do not have the technology to replace the function (for example, what inventor can lay claim to a machine that regulates the global climate?)."[45]

Once the point sinks in that resources are essentially human constructs in the sense that they depend on human interests, knowledge and institutions for their existence, it's easy to press the point too far. It's easy to think that in principle at least there is always and everywhere some appropriate "fix" (technological, economic or whatever), something that might be thought and done, that will create resources where none appeared to be. People who hold this kind of view have been called "cornucopians", for fairly obvious

reasons.[46] For these folks, the human contribution to the creation of resources is not only necessary: it's even sufficient. In the most simplistic sort of cornucopianism, the assumption is made that everything is producible at some price. As Kaysen put it, "Resources are properly measured in economic, not physical, terms. New land can be created by new investment, as when arid lands are irrigated, swamps drained, forests cleared. Similarly, new mineral resources can be created by investment in exploration and discovery."[47] Laxer claimed that " ... reserve figures (for oil and gas) and producibility estimates are not calculations of physical quantities, they are *economic assessments* of what can be produced at any given time."[48]

Fortunately, there is a reasonable position to take to correctly interpret the phrase "obtainable by conventional methods" when it's applied to resources. The position is short of cornucopianism on the one hand and on the other hand it doesn't misleadingly suggest that resources are person-independent. Cook came very close to articulating the view when he claimed that

"The ultimate limit to exploitation of earth resources ... is the limit of net energy profit (or work savings). When it takes more energy to find, recover, process, and transport the fossil fuels than can be gotten from them in useful form, there will be no more, oil, gas or coal reserves."[49]

What he should have said was even more general, since what is at stake is nothing short of a specification of rational action. That is, something may be regarded as a resource and obtainable by conventional methods insofar as the benefits of obtaining it are at least as great as the costs (in the broadest senses of the terms 'benefits' and 'costs').[50] Cook seemed to realize that the "ultimate limit" was broader than he had allowed, for he said that

"That limit to a resource also may be determined by the unwillingness of society to pay the cost of its exploitation, even though an energy surplus (or saving) might be obtained thereby. According to Sahlins ... many primitive societies preferred to take their energy surplus in leisure rather than in goods (stored energy or work) and deliberately abstained from exploiting available potential resources that could have increased their surplus. Some primitive agricultural societies still do this."[51]

Without an appreciation of the depth of the issue involved in the specification of a plausible interpretation of the phrase "obtainable by conventional methods," it's impossible to understand the depth of the division between some optimists and pessimists with respect to the environment and resources. People who object to the development of nuclear energy, to clear-cutting national forests or redirecting the flow of rivers even though such projects

may yield a net increase in energy may appear completely irrational if one doesn't assess the projects in the light of all the benefits and costs. Whether or not they *are* completely irrational is beside the point. The point is that one cannot see what they are seeing and therefore cannot judge what they are judging unless one perceives the projects through the broad lens that they are using.

Supposing one is committed to examining all the benefits and costs in terms of energy exchanges, monetary exchanges and so on, there are an enormous number of complicated problems to be solved in order to determine exactly what is obtainable by conventional methods. I have discussed the full range of these problems elsewhere and will not undertake that again here.[52] However, it is worthwhile to mention what I call "the recipient population problem."[53] That is the problem of deciding exactly who should be considered when assessing the benefits and costs of any action. The position I defended in my earlier book still stands: Everyone affected by any person's action belongs to the class of individuals whose benefits and costs ought to be considered by the actor. Since one seldom knows exactly who will be affected where, when and how, the most that can be demanded is a sincere effort to estimate the consequences of one's actions. Still, such estimates constitute much of the difference between moral and immoral action. In short, then, the answer to the question 'Whose benefits and costs should be considered in deciding what is obtainable by conventional methods?' is 'Everyone affected by the required methods.' In economists' jargon this answer is tantamount to the view that there are no externalities. In terms of Commoner's folksy laws of ecology, this answer is a corollary of 'Everything is connected to everything else.' And in terms of Martin Luther King's favourite spiritual, it's a corollary of the view that "We are all in the same boat brother; so you can't rock one end without rockin' the other."[54]

4. ENERGY

In 1973 the Chairman of the U.S. Senate Committee on Interior and Insular Affairs, Henry M. Jackson, "asked the Environmental Policy Division of the Library of Congress to compile a comprehensive summary of environmental affairs in the 92nd Congress, to be published as a committee print and made available to the public."[55] I have drawn heavily on that 1145 page document throughout this chapter. On page 19 it says that "The concensus perception of the energy situation in the United States is characterized by such words as 'crisis', 'dilemma', 'crunch' and similar terms connoting rapid change with

adverse effects and rationalization."[56] Similarly, Sporn began his article in *Science* with the assertion that "We [Americans] face a crisis in total energy and in electric energy. The total energy crisis is the more basic and serious of the two."[57]

I have already cited Laxer's book on *Canada's Energy Crisis*. "That the world faces crisis" he wrote, "is beyond dispute."[58] Moreover, " . . . Prime Minister Pierre Trudeau has warned Canadians that objectives like full employment and higher living standards may be unrealistic."[59] The realization of such objectives presumably becomes problematic because

"The energy situation is closely inter-related with a number of economic issues. These include the country's balance of trade, competitiveness in international markets, the capital requirements of necessary energy development, the employment generation of energy development or energy conservation, the relationship of energy costs to inflation, and the difficult balance to be achieved between reducing energy demand and needed economic growth."[60]

The views of ordinary folks in both countries did not match the views of the educated elite. In the United States, a national survey undertaken in November 1973 by the National Opinion Research Center found that " . . . while a majority of the public consider the energy shortage an important problem, only about 25% feel that it is the most important problem facing the country today."[61] A Canadian Institute of Public Opinion (CIPO, Gallup Poll) release three months later said that only 21% of a national sample mentioned "the energy problem" in response to the question "What would you say is the greatest single problem facing the provincial government in your province today?"[62] Two months later the CIPO reported that 67% of a national sample gave a negative response to the question "In your opinion is there or is there not an energy crisis in Canada?"[63]

One reason for the discrepancy between the views of ordinary people and the educated elite is the different information available to both groups. Another reason involves the confused ideas reviewed in the previous section concerning resources, reserves and what is obtainable by conventional methods. The following remarks by Fischman and Landsberg address this point from several different directions.

"What is a 'shortage,' and what is 'adequacy'? Is the supply of a given mineral 'adequate' only if it continues to be forthcoming in the 'required' amounts at present relative prices, or at prices rising no more rapidly than has been the trend, even if that trend reflects increasing supply stringencies? What if the only means of avoiding marked price change is the initiation of unaccustomed efforts at conservation, reuse, and recycling, or the making of major investments toward technological advance? Is adequacy measured

in terms of current levels of minerals, exploration, evaluation, and development, or trend levels? May a mineral be considered adequate just because it can be geologically inferred to exist in sufficient quantity, even if it takes major new outlays in exploration, evaluation, and development to find this quantity and get it into production?"[64]

Everyone convinced of an energy crisis or a shortage seems to have an explanatory hypothesis too. The most comprehensive list of culprits was given by Sporn. In his opinion, the crisis was "the result of a breakdown at the various levels of our society dealing with energy and by the failure of institutions at each level to carry out their roles in a far too fragmented chain of overall responsibility."[65] In particular, he cited the failures of Congress, the executive branch, the Department of the Interior, its Office of Oil and Gas, the Federal Power Commission, the Securities and Exchange Commission, state regulatory commissions, electric utilities, gas utilities, the oil industry, the coal industry, the automobile manufacturers and members of the environmental movement.[66] The only specific group he neglected to mention was that of "energy deficit spending" farmers. According to Dubos, "there are many situations in which the modern farmer spends more industrial calories than the food calories he recovers in the form of food."[67]

The curious thing about this list of culprits is that it doesn't include any clear reference to waste. Perhaps with the exception of Dubos's remark, it's entirely oriented toward business-as-usual production and energy supply, without any hint that there is anything wrong with the demand for energy in North America. As our analysis proceeds, it will become clear that the demand side of the energy problem is precisely the side that requires the most attention and holds the greatest promise for a satisfactory resolution of the greatest number of problems. At this point, I only want to mention two relevant allegations. First, "West Germany uses only half the energy used in Canada to create an equivalent unit of production."[68] Second, "Four nations with per capita incomes comparable to [that of the United States] consume less than half as much total energy per capita."[69] The four countries are Sweden, Denmark, West Germany and Switzerland. I call these "allegations" not because they are more uncertain than any other claims made here, but because (as we have already seen) it's difficult to elevate any claims in this area to the status of established facts. Indeed, before we proceed to the basic statistics on energy, a few more remarks on our data base will be helpful.

Addressing the problem of comparing estimates of oil and gas resources and reserves in Canada, the authors of a report from the Department of Energy, Mines and Resources (cited earlier) wrote that

"Comparing estimates is difficult and sometimes misleading, but it is a necessary and an inevitable exercise. Comparisons are made difficult by the failure of many estimators to state clearly the basis upon which their estimates have been prepared. It is necessary to know exactly what is being estimated: Does it include past production? Are reserves included? Are the quantities technically recoverable or in-place? If they are technically recoverable, are they economically recoverable? Has an economic cutoff been used? If so, at what level? Are natural gas liquids included? and so on."[70]

In 1974 the firm of Urwick, Currie and Partners Ltd. did an analysis of the data base for energy consumption statistics in Canada and concluded that "it is clear that no format currently used by Statistics Canada, Environment Canada or the National Energy Board is suitable for use by the Office of Energy Conservation to display energy consumption statistics. There are two aspects to this basic problem: no explicit linkage with patterns of end use exists; structural technical reporting difficulties produce misleading estimates of consumption."[71] Some of the details of these "two aspects" will be presented when statistics on particular minerals are reviewed.

In response to questions concerning problems of energy self-sufficiency and economic growth in the United States, Senator Henry Jackson told *Science's* interviewer:

"I'm no expert, but I try to make judgments. I use the seat of my pants in cooperation with my head, and I have come to the conclusion that there are no experts in this area. I listen to the 'experts,' and I have found them so wrong on what prices were going to be, on what they thought would happen in the Middle East. . . . When I ask key people for data, they don't have it, but they say Joe Blow that's sitting out in university 'X' is thinking about it. I mean I find it very discouraging, and I'm constantly talking to the brightest people I can find to give me inputs; the government has been remiss in this area."[72]

The aggregated energy statistics summarized in T2 and C1 (Chart 1) originate from annual surveys of the United Nations Statistical Office. The data cover "only commercial forms of energy" due to the "paucity of reliable and detailed information on non-commercial fuels" such as "fuelwood, bagasse (plant residue), dung, paddy husk or other vegetal wastes."[73] To simplify the presentation, I will use the term 'energy' as short for 'commercial energy'. Statistics on coal, lignite, crude petroleum, natural gas and natural gas liquids, hydro and nuclear generated electricity have been converted to metric tons of coal equivalent. Thus, in 1974 for example, Canada produced about 280 million metric tons of coal equivalent of energy, compared to about 2100 produced by the United States (T2). Total consumption that year was 220 million metric tons of coal equivalent in Canada, and 2433 in

the United States. The latter figures mean that on a per capita basis, Canadians consumed about 9800 kilograms (nearly 10 metric tons) of coal equivalent of energy, and Americans consumed nearly 11 500 (11½ metric tons) (T2, C1). That represented a 46% increase over 1964 for Canadians and a 30% increase for Americans.

Several authors have noticed a high correlation between energy consumption and various measures of living standards. For example, Lincoln said that "Intermediate demand expenditures for energy (for consumer products) are related very closely to the gross national product (GNP); the ratio of the two has varied less than a quarter of a percent over more than a decade."[74] The U.S. Commission on Population Growth and the American Future claimed that "The reason per capita income in the United States is so high is that the average American worker has at his command more energy, chiefly in the form of electricity, than any other worker in the world."[75] Mazur and Rosa looked at statistics for 55 countries and found that "nearly all the life-style indicators correlate highly with all measures of energy consumption."[76] They correctly cautioned readers, however, with the remark that "This pattern of correlations does not prove that energy consumption influences these life-style indicators, but it is consistent with that argument."[77]

At least one researcher has argued that in the united States, at least, there has been a negative correlation between energy use and economic growth. According to Goldberg,

> "Since 1850, periods of rapid economic and technological growth have been typified by increased efficiency in the use of energy, and periods of slackness have been typified by the increasing inefficiency with which we use our energy. While there does seem to be a definite relationship between the use of energy and growth, it seems to be a negative relationship. The more efficiently we use energy, the more rapidly we grow, which means we use relatively less energy."[78]

More than one author has noticed that "new productive technologies" have often been "more costly than the technologies they have displaced, in consumption of electric power and other forms of fuel-generated energy *per unit economic good*."[79] What's more, for general assessment purposes, this sort of observation seems to provide the key to an appropriate interpretation of energy use statistics. I think it is safe to say that no one has ever regarded energy use as an end in itself or something to be sought as good in itself. Even energy sellers are interested in increased consumption as a means to something else, e.g., making money for sellers. Thus, it seems clear that energy use should be treated as an expenditure or cost. Hence, in accordance with

my general policy on costs, I regard the annual per capita consumption of energy in kilograms of coal equivalent as a negative social indicator. Therefore, Canada received 11 points for its preferable stock values in the 1964–74 period, leaving nothing for the United States. For its preferable annual flow values, Canada gets 2 points and the United States gets 8.

Recognizing energy use as a kind of expenditure or cost is the first step on the road to a national policy of energy conservation. I will have more to say about conservation in Section 22. In the remaining paragraphs of this section I want to address the issue of energy self-reliance. Canada and the United States both have national policies in favour of self-reliance. According to Sampson,

"In November 1973 President Nixon ... made a stirring television speech, proposing his Project Independence: the United States must become self-sufficient in energy by 1980, by increasing its drilling and use of other fuels, and by massive spending on nuclear research – a new kind of Manhattan Project. ... By the end of the year Project Independence was a joke, and self-sufficiency by 1980 inconceivable; by the end of 1974 the United States was more dependent than ever on Arab oil."[80]

When Senator Henry Jackson and William E. Simon (Head of the U.S. Federal Energy Office) were interviewed in the spring of 1974 for *Science*, they gave no hint of laughter. Both men were explicitly committed to achieving energy self-sufficiency as soon as possible.[81] Indeed, I think virtually everyone in North America felt that way by 1974, and probably earlier.

The Canadian government officially "adopted a national energy strategy of self-reliance" in 1976. In *An Energy Strategy for Canada* (*Summary*): *Policies for Self-Reliance*, it was asserted that "The overall objective of the National Energy Strategy which the Government of Canada has adopted is *energy self-reliance*."[82] On the next page a "general target" of "energy self-reliance within ten years" was announced.[83] "Self-reliance" the report said, "means reducing our vulnerability."[84] In particular, it meant reducing "our net dependence on imported oil in 1985 to one third of our total oil demands," and maintaining "our self-reliance in natural gas until such time as northern resources can be brought to market under acceptable conditions."[85]

A strategy of self-reliance might be regarded as a corallary of the perennial obsession of many Canadians, i.e., the achievement of independence from the United States in every conceivable way.[86] But independence can be expensive. Another report of the Department of Energy, Mines and Resources pointed out that

"Achieving an optimal allocation of resources is a finely balanced process and pursuing

a policy of self-reliance raises many potential problems. How much of an insurance premium should Canada be willing to pay for domestic rather than foreign energy? What is the appropriate division of the economic gains and losses which this policy might cause among the different sectors of Canadian society? To what extent should interfuel substitution be encouraged beyond what would be produced by the operation of market forces alone?"[87]

The last two questions, on trade-offs and fuel substitution, arise repeatedly in later discussions of particular fuels, environmental policies and waste management.

Granted that energy self-reliance is a recognized goal of Canadians and Americans, it would be helpful to have at least a rough measure of the achievement of that goal. We have already seen that the official Canadian idea of self-reliance does not imply the absence of all fuel imports. In official reports, the term 'self-sufficiency' is used to designate that sort of independence.[88] So far as I know, no one expects or even wants to eliminate all fuel imports or exports. As one would expect and I will show in detail later, some fuel exchanges are mutually beneficial. So the ratio of the total energy produced to that consumed would not be sufficient as a measure of energy self-reliance. This ratio could be greater than one, as it frequently was for Canada in the 1964–74 period (T3, C2), although the country was not self-reliant. However, the ratio does seem to measure a necessary condition of self-reliance. That is, insofar as the ratio of energy production to consumption is less than one, there is an energy deficit. Whether the deficit is a result of using more energy than is being produced or of exporting too much of what is produced or some combination of both, as long as there is a deficit there cannot be self-reliance. No one with a commitment to energy self-reliance would willingly operate with a persistent energy deficit. Accordingly, I think it is reasonable to regard the total energy production to consumption ratio as a positive social indicator. In 1974 Canada's ratio was 1.28, compared to 0.87 for the United States (T3). That represented an improvement over 1964 of nearly 30% for Canada, and a 10% decline for the United States. For its superior stock values during the decade then, Canada makes 10 points and the United States makes 1 in our general assessment. For its superior annual flows, Canada makes 7 points and the United States makes 3.

5. ENERGY CONTROL

In the final chapter of *The Last Play: The Struggle to Monopolize the World's Energy Resources*, Ridgeway wrote that

"The domination of oil, gas, coal, and uranium by large energy trusts has helped to create its own energy crisis, raising prices, changing markets, carving out new resource colonies, leading to growing disparity between rich and poor."[89]

By 1970, he claimed, "the oil industry controlled the coal industry,"[90] and "45% of all uranium resources."[91]

Similar indicators of industrial concentration in the energy field were reported in many of my source materials. For example, Laxer claimed that by 1969 "oil companies had taken over coal firms controlling 36% of the U.S. coal market" and that these same companies controlled "84% of U.S. refining capacity, 72% of national gas production and ownership of reserves, 30% of domestic coal reserves, over 50% of uranium reserves, and 25% of uranium milling capacity."[92] An article in *Newsweek* claimed that "oil combines" controlled "more than 20% of coal production,"[93] while the American Public Power Association put the figure at "23% in 1969"[94] and Sykes put it at 28% in 1970[95].

Since there are plausible theoretic reasons and there is convincing empirical evidence for the view that industrial concentration in the form of monopolies or oligopolies tends to create inefficiency and higher prices, there are good grounds for suspicion concerning the origins of the energy crisis.[96] Although I am persuaded that concentration is a big part of the energy problem, I do not have and have not seen a knock-down demonstration of this position. Indeed, I don't even think it's possible to produce such a demonstration given current data limitations and conceptual complications. So I'm not going to try. On the other hand, given the frequency of appeals to industrial concentration as the root of the energy crisis and the diversity of statistics bandied about, it seems worthwhile to mention briefly the results of a U.S. Federal Trade Commission report on the subject.[97] The aim of the report is to clarify the American situation; but given the dominance of the United States in North America, it is plainly relevant to the Canadian situation. Its relevance will become even clearer as we proceed to detailed discussions of particular mineral resources and American ownership of Canadian industry. I would like to emphasize again that my purpose in discussing the report is not to provide evidence of too much concentration or of the origins of the energy crisis. It's only to share the best information I've found on the question of industrial concentration and control in the field of energy.

Concentration can be regarded as a function of the competition in any industry. In principle, if there were only one firm producing goods or services in some industry, then it would have a monopoly on production and the productive capacity of the industry would be concentrated 100% in that firm.

If one firm produced half the total product in some industry and every firm was producing to full capacity, then the productive capacity of the industry would be concentrated 50% in that one firm. Generally speaking, then, "seller concentration has typically been expressed in terms of a concentration ratio, defined as the share of output controlled by a designated number of the largest firms within an industry."[98] In other words, "Seller concentration is usually described in terms of a concentration ratio, defined as the percent of industry output accounted for by the x largest firms (typically 4, 8, 20, and 50 . . . .)".[99]

Three points should be emphasized about concentration ratios in the energy industry. First, many of the data problems mentioned earlier concerning the identification of resources and reserves are still relevant, and there are others.[100] Second, there are serious problems involved in the selection of appropriate markets and geographical regions of analysis for measuring concentration ratios. Problems concerning appropriate geographical regions are fairly obvious. Companies may dominate energy supplies in certain towns, counties, states or regions without dominating supplies in nations as a whole. A report written by the Department of Energy, Mines and Resources for the 1978 meeting of the International Executive Council of the World Energy Conference describes the Canadian situation as follows.

"In effect, each region of Canada has developed its own energy bias, largely as a result of geographic factors and resource availability. Some regions, such as the Atlantic provinces and the north, rely primarily on oil. Others, such as B.C., Quebec, and Manitoba, depend more on hydro-electricity (while still consuming large amounts of oil). Alberta and Saskatchewan obtain more than three quarters of their energy needs from oil and gas, and consume relatively large amounts of coal as well. Ontario is perhaps the most diversified province with respect to energy consumption, with almost 40% of its needs being satisfied by oil, 23% by natural gas, 15% from coal, 13% from hydro, and 9% from nuclear in 1977. Ontario is the only province with operating nuclear capacity at the present time."[101]

Although similar regional disparities exist in the United States, the FTC report is based on the "*combined national* production of each primary fuel: crude oil, natural gas, coal, and uranium."[102] (Emphasis added.) So its results may yield very misleading assessments of concentration ratios in smaller areas of production. In this respect, the FTC report has precisely the kind of limitation that this whole book has.[103]

Having selected a particular geographic region of analysis, there is still a problem of deciding which elements of the total economic activity in the region belong to the relevant market. The FTC report is again instructive.

"The multiplicity of potential markets is best illustrated by reference to the oil sector (sometimes called the petroleum sector) with its numerous stages of production (crude oil production, transportation, refining, marketing) and its distinct products (residual fuel oil, gasoline, distillate, etc.) serving all the major energy consumption sectors (transportation, electric utilities, industry, residential/commerical)."[104]

The "combined national *production* of each *primary fuel*" (Emphasis added.) referred to above clearly represents only one roughly manageable market designation out of a vast number that might have been selected for an analysis of concentration ratios.

The most comprehensive summary table in the FTC report is included here as T4. For the four primary fuels and their combined values in terms of British thermal units (B.t.u.'s)[105] or dollars, the trends are quite clear. In every case the production concentration ratios increase in the 1955 to 1970 period, for groups of the top 4, 8, and 20 firms.[106] For example, the top 8 American firms in 1955 produced 22% of the energy (in B.t.u.'s) in the United States, while in 1970 the top 8 firms produced 31.6%. The dollar value of the production of these 8 firms in 1970 represented 37.8% of the total dollar value of energy produced that year in the United States. In terms of primary fuels, in 1970 these 8 firms produced 49.1 percent of American crude oil, 39.1% of natural gas, 41.2% of coal and 80.0% of uranium[107] (T4).

Apart from all the problems underlying such statistics, their interpretation is far from clear. Is it, for instance, good, bad or indifferent that the top 8 firms produced 49.1% of American crude oil in 1970? Would 39.1% have been better and, if so, exactly how? Would that have yielded a noticeable difference in the pricing behaviour or productive efficiency of the 8 firms? Is what 20 firms control more or less important than what 8 control, or 4?

If one compares the 4-firm concentration ratios of T4 with those of some other industries, the energy industry doesn't look so bad. As T5 shows, gold mining has a 4-firm concentration ratio of 79.9% and manufacturing has 40.1%. Of course the fact that there is more concentration in, say, gold mining doesn't prove that the level of concentration in the energy industry is acceptable, good, useful or anything else. That is precisely the problem, and perhaps the authors of the FTC report said as much as anyone could justifiably say on this score.

" . . . production concentration in a national energy market appears to be quite moderate, especially compared to many other industries. On the other hand, energy concentration rose significantly between 1955 and 1970. . . .

The information reported in this study appears to suggest that petroleum company acquisitions of coal companies up to 1970 may not have had a severe impact on energy

production concentration. Consequently, this study does not provide any positive support for the proposal that petroleum companies be banned from acquiring coal or uranium companies; nor does it suggest that petroleum companies be banned from acquiring coal or uranium reserves. Nevertheless, because petroleum company acquisitions of coal and uranium companies can be viewed as horizontal acquisitions, they definitely should be subject to antitrust review for possible anticompetitive effects. Both interfuel and intrafuel mergers should be given close scrutiny, particularly if energy concentration continues to rise as it did between 1955 and 1970.

It should also be noted that even though energy concentration and concentration in each of the three fossil fuels is relatively low, that low concentration may understate the degree of economic power of the largest firms in those industries. For example, concentration is higher in petroleum refining and retail sales than it is in crude oil production. Moreover, there are large numbers of joint ventures involving petroleum companies which suggest that the large companies may not act as independently as the low concentration figures would otherwise suggest. Similarly, in addition to the fact that uranium mining and milling are highly concentrated, concentration in the later stages of nuclear fuel processing is higher than it is in milling or mining. These examples suggest that in the energy sector many other factors besides the relatively low concentration ratios should be considered in any review of possible anticompetitive structure or behavior.

Although many petroleum companies are known to be acquiring coal and uranium reserves, *this study provides little information on reserves acquisitions because the necessary data are not available from published sources*. If petroleum companies are acquiring significant amounts of coal and uranium reserves, then in the future they may control a rising fraction of coal and uranium production. In that case, energy production concentration may rise significantly as petroleum companies become more dominant in coal and uranium production. However, it would be necessary to obtain unpublished data which petroleum companies view as highly confidential in order to analyze that possibility."[108] (Emphasis added.)

The emphasized sentence is worth remembering. It tells us that the American agency responsible for regulating "anticompetitive structure or behavior" in the energy industry did not have adequate data to do its job.

6. ELECTRICITY

In Volume III, Chapter 6.13 we saw that by 1974 over 98% of North American households had electric refrigerators and nearly 80% had electric washing machines. In Chapter 8.4 it was noted that by 1974 virtually all American and 98% of Canadian households had radios, while 96% of the homes in both countries had television sets. Given this massive saturation with electronic gadgets, one would think that North America runs on electricity. Insofar as practically every household in North America would be significantly disrupted if all the electricity were turned off, there is more than adequate

justification for such thoughts. However, if one raises the question 'What percentage of all the energy used in North America is consumed in the form of electricity?' the picture changes.

Although it has been impossible to find exactly comparable figures, the general situation in both countries is roughly discernable. According to the United Nations study from which our energy statistics were drawn, in 1974 11.8% of the Canadian and 2.2% of the American total energy consumed was in the form of electricity generated from hydro or nuclear plants.[109] However, as T6 and F1 show, about 80% of the electrical energy generated in the United States is from thermal plants, which burn solid or liquid fuels, or natural gas. So the American figure of 2.2% should be about one fifth the actual value, or about 11%. That is, about 11% of the total energy consumed in the United States in 1974 was in the form of electrical energy. Using a similar line of reasoning, since the 11.8% Canadian value represents about 80% of the electricity generated (T6, F1), about 15% of the total energy consumed in Canada in 1974 was in the form of electrical energy. This Canadian figure of 15% is pretty well confirmed by a recent Statistics Canada publication that puts the 1972 figure at 14.3% and the 1976 figure at 15.8%.[110] I haven't found any reports confirming the American figure, but I don't see how it could be far off the mark. Granted that the figures are roughly accurate, it's remarkable that electrical energy consumption represents such a small percentage of the total energy consumed in societies so saturated with electronic gadgets as Canada and the United States.

In very round figures, in 1974 Canada consumed nearly three hundred thousand million kilowatt hours of electricity, compared to about two million million in the United States (T7). While the production to consumption ratios for electricity typically tend to be one (T7), there is a substantial amount of exporting and importing of electricity between the two countries. Typically and increasingly the United States is on the receiving side (F2). In 1974, for example, over 15 000 gigawatt[111] hours of electricity were imported into the United States and only about 2000 gigawatt hours were exported to Canada. The former was less than one percent of the total American electricity needs that year, and it was about 7.5% of the total electricity produced by Canada (T7, F2).

Transfers of electricity between the two countries began in 1901 with a 12 kilovolt transmission line at Niagara Falls carrying Canadian hydroelectric power to the United States.[112] By 1979 there were "over 100 international power lines, ranging in voltage from 115 to 765 000 volts."[113] There were "some twenty-nine bulk power interties rated at 69 kilovolts[114] or higher

between the Provinces of New Brunswick, Ontario, Quebec, Manitoba and British Columbia and the United States."[115] Figure 3 schematically illustrates these 29 power lines. All these lines are part of an elaborate system that integrates the supply of electricity throughout North America. The system is co-ordinated by nine Regional Electric Reliability Councils depicted in F4.

There are several good reasons for having an integrated supply system of electrical energy in North America. Because the supply of such energy is highly regulated by government, it's necessary for utility companies to maintain a specified capacity whether current demands require it or not.[116] The existence of secondary markets provided by integrated networks decreases the likelihood of wasted capacity. Such networks also reduce the need for many relatively small plants that cannot realize the economies of scale of larger plants. The networks allow fairly remote generating plants to serve as back-up systems in emergencies.[117] They also provide opportunities for co-ordinated planning, operation and maintenance of generating plants.[118] All of these advantages lead directly to lower investment requirements for new developments and improvements in what is "without doubt the most capital-intensive of all economic enterprises."[119] According to Nagel, electric utilities require "approximately $5 of investment per dollar of annual revenue. . . . in sharp contrast to most manufacturing industries, which require $1 or less of investment per dollar of annual revenue."[120]

Even with the massive integrated network of electricity transmission in place, there are vast differences in the main supply sources for the nine regions in the system. Table 8 summarizes the fuel sources for some regions and provinces. The differences have profound implications for energy conservation and waste, for the future development of the areas and for the positions of elected officials with respect to nuclear energy and environmental protection. For example, with 99% of their electricity coming from hydro plants, Quebeckers can take a hard line on the development of nuclear energy. With 89% of their electricity coming from coal-burning plants, the people in the East Central Area (Michigan, Illinois, Indiana, Ohio, Kentucky, etc.) may not be able to afford to take a hard line on environmental pollution. Since about two thirds of the energy in coal and oil is lost in waste heat when these fuels are burned to produce electricity,[121] the states and provinces dependent upon such sources may be obliged to take soft lines on energy conservation. Although I can't go into the regional-level problems, some of the trade-offs involved with the use of different fuel sources for electricity will be introduced when each source is discussed. In the best of all possible worlds, we would be able to assess all the benefits and costs of using any

particular fuel source, and choose an optimum mixture of sources for all areas. The next few sections will give you a rough idea of how far we are from the best of all possible worlds.

7. RISK ASSESSMENT

One of the most important questions to be raised concerning the use of any fuel for the production of energy is its effect on human health. For example, if the electrical power capacity in some area had to be increased by the construction of coal-burning or nuclear fission plants, the estimated risk (probability) of deleterious health effects from each alternative would be high on the agenda of information required by decision makers. 'Risk assessment' is the name given to the task of estimating such risks.

There are general problems more or less present in any assessment of the the health risks involved in the development and use of any technology or material, and there are specific problems attached to particular kinds and individual cases. Some of the general problems will be mentioned here, while specific problems will be considered with particular technologies and materials.

In a thoughtful article published in 1977 called the "Public Health Hazards from Electricity-Producing Plants," a distinguished statistician claimed that

> " . . . in spite of the many important studies performed, there is currently no reliable methodology to estimate how many more cancer cases, and how many more heart attacks and other diseases have to be anticipated as a consequence of the normal operation of this or that type of electric generator. In part, this is because the currently available estimates of radiation effects on humans are based on extrapolations from studies of two kinds. Those of one kind may be exemplified by studies of atomic bomb casualties in Hiroshima and Nagasaki. The other kind are laboratory experiments with lower animals, frequently mice. The unreliability of both kinds of extrapolations is connected with the following circumstances: (1) The omnipresent troublesome phenomenon of competing risks, (2) The dependence of health effects of a given noxious agent on the preexisting local pollution, (3) The dependence of health effects not only on the "dose" of an agent, but also on the rate at which the agent is administered, (4) The noted difficulties of making extrapolations from one mammal to another."[122]

"Competing risks" include everything in one's inherited and environmental composition that might contribute toward morbidity or mortality. Since North Americans are exposed to several distinct kinds of carcinogenic agents, it is virtually impossible to isolate the effects of any one of them on any individual.[123] From toxicological studies on animals in controlled laboratory

conditions, we know that different species have different levels of susceptibility to various kinds of diseases in the presence of various kinds of causal agents. We also know that there are significant levels of susceptibility among individuals in the same species.[124] All variations in susceptibility and causal agency are in effect in competition for decisive influence on the life and health of particular individuals, placing them at diverse levels of risk.

"Preexisting local pollution" is another factor contributing to the difficulty of isolating the necessary and sufficient conditions of disease and death. The interaction of new agents with background pollution may have additive, synergistic or antagonistic effects. For example, the introduction of a new carcinogenic agent in some area might double the number of agents and effects (additive effect), double the agents and more than double the effects (synergistic effect), or double the agents and cancel out their effects (antagonistic effect).[125]

The rate at which given doses of a causal agent are introduced into an organism or its environment has a direct bearing on its effects.[126] Exposure to a certain dose of some agent over a long period of time may allow a host organism to accommodate it without harmful effects, while a sudden assault of the same dose in a brief period might be fatal.

Neyman thought that "The problem of estimating deleterious health effects of additional pollution of one kind or another may be solved through a large, interdisciplinary, multipollutant, and multilocality epidemiological study."[127] The trouble is, as the U.S. Council on Environmental Quality explained, North

> " . . . Americans are extremely mobile, changing jobs and homes and moving around the country. It is often difficult to isolate or even remember exposure experiences that occurred many years or decades earlier. . . . Studies on humans are in general expensive and lengthy, and involve following large numbers of people who have been exposed to [a] study chemical. For new chemicals where there is no current human experience, however, such studies cannot be used to evaluate health effects without resorting to human experimentation. Thus, epidemiological studies of human experience have limited use. Even at best, detailed information of this type will not be generally available in the next 10 to 15 years . . . ."[128]

Whether the issue is the introduction of new chemicals or new technology, fairly standard sorts of problems arise with respect to the assessment of the risk to human life and health. In the next section we will consider a technology that presents extraordinary problems of risk assessment.

8. NUCLEAR FISSION

Considering the facts that in 1974 less than a fifth of the energy consumed in North America was in the form of electricity and about one twentieth of that electricity was generated from nuclear fission (T6, F1), the furor over nuclear energy is incredible. Even before the accident at Three Mile Island on March 28, 1979, North Americans were severely divided on the question of the wisdom and morality of national commitments to nuclear power.[129] I plunged into the literature determined to give all sides a fair hearing and to try to decide for myself if one ought to be for or against the continued use and development of nuclear power. It has been a thoroughly fascinating experience with a completely unsettling and unsettled result. All things considered, I think that wisdom and morality are on the side of curtailing dependence on nuclear power. Such curtailment would not be costless, but the costs of noncurtailment seem to be much higher. Some day we may have adequate information and management systems to allow substantial increases in our use of nuclear energy, but that day seems to be a long way off yet. In the remaining paragraphs of this section I will try to substantiate these allegations.

For our purposes very little physical theory has to be understood in order to grasp the controversial issues concerning nuclear power. In all electric power plants, electricity is produced by spinning turbines which in turn spin generators. The turbines are turned by the pressure of falling water in hydro plants and by the pressure of steam in thermal and nuclear plants. Steam may be produced by boiling water or by passing water through a heat exchanger.[130] In either case, the required heat is produced in thermal plants by burning something (e.g., coal, oil, gas, wood or municipal waste) and in nuclear plants by fissioning uranium-235 (U-235).

Typically less than one percent of uranium ore contains the metal itself, and the latter is a mixture of two relatively stable isotopes, U-235 and U-238.[131] To say that natural uranium is formed by a mixture of two relatively stable isotopes is merely to say that the chemical properties which characterize this metal may be produced by different atomic building blocks. U-238 has an atomic weight of 238 hydrogen atoms (each of which has an atomic weight of one), and U-235 has three less. Unfortunately, the fissionable isotope U-235 typically represents less than one percent of the metal itself. Ninety-nine percent of pure uranium is U-238. In 1974, Canada produced about 4800 short tons of U-238, while the United States produced about 11 500 short tons[132] (T9).

In the core of a nuclear reactor, neutrons are shot at uranium to explode (fission) the nuclei of atoms of U-235, release energy in the form of heat and send out other neutrons to repeat the process.[133] Thus, a chain reaction is created "with neutrons passing from nucleus to nucleus."[134] During this process, the nuclei of atoms of U-238 may "swallow up neutrons, [producing] . . . an element which does not exist in nature but which is itself capable of sustaining a chain reaction, just as for U-235. It is called Plutonium, or Pu-239."[135] While plutonium is fissionable and is occasionally fissioned in currently operating reactors, it is extremely dangerous to work with and most of it is processed as a kind of waste product.[136]

The preceding three paragraphs contain a brief outline of aspects of the processes of generating electricity that are similar in Canada and the United States. However, due to the use of different types of nuclear reactors in the two countries, there are important differences in the production of electricity from nuclear fission. Canada uses a reactor called CANDU (short for Canadian Deuterium Uranium Reactor), which has been described as "the outstanding Canadian technological achievement of this century."[137] The main difference between CANDU and American reactors (which in other ways are not all the same) is that the former runs on natural uranium and is cooled by heavy water (deuterium oxide, D_2O), while the latter run on enriched uranium (uranium with 2 to 4% U-235) and ordinary water (light water, H_2O).[138] There seems to be general agreement that CANDU is safer to operate than any American models mainly due to the latter's need for enriched fuel.[139]

There are few, if any, uncontroversial alleged benefits and costs of using and continuing to develop nuclear power. Moreover, most of the assessments made have been comparative judgments, i.e., nuclear energy is judged to have some advantage or disadvantage compared to some other source of energy. I will list the alleged advantages first. Nuclear energy is supposed (1) to be a hedge against increased dependence on uncertain oil supplies;[140] (2) to be less expensive (in dollars) than energy from fossil fuels;[141] (3) to use a mineral (uranium) that is practically worthless for other purposes;[142] (4) to require less space in storage and transportation facilities ("Fissioning one ounce of U-235 produces as much heat as burning 100 tons of coal.")[143] (5) to involve fewer fatalities and less morbidity;[144] (6) to have no smoke, dust or ash typically associated with fossil fuels;[145] and (7) to be relatively efficient.[146]

The disadvantages or costs (in the broadest sense) of the use and development of nuclear energy are supposed to include the following. (1) There will be an increase of morbidity and mortality from accidental high-level and

routine low level exposure to radiation.[147] (2) There have been and will be excessive costs (in dollars) that destroy opportunities to explore alternative forms of energy production.[148] In 1971 15% of the Canadian and 5% of the American government expenditure on research and development went into civilian nuclear energy (T10). That was about 3 (1964 US) dollars per person (T11). In 1977 it was claimed that "In Canada 75% of the government research and development budget for energy [was] directed to nuclear energy,"[149] compared to 55% in the United States.[150]

(3) There will be an increase in the proliferation of nuclear weapons as a result of marketing things like "the outstanding Canadian technological achievement" all over the world.[151] The atomic explosion in India on May 18, 1974 was traced back to material from Canada's original peaceful gift to that country.[152] Table 12 lists the countries of the world with some nuclear power capability as of December 1975. (4) There will be increased opportunities for sabbotage, terrorism and theft at nuclear reactor sites, waste disposal sites and along transportation routes from one to the other.[153] (5) There will be uranium shortages.[154] (6) The highly technical nature of nuclear energy requires the training and sustaining of a group of technical elites, which breeds all the evils of elitism.[155] (7) On top of elitism, and worse still, will be the development of paramilitary personnel, specially trained to secure the reactors and waste product sites, and transported material.[156]

(8) There is an increase of social and psychological stress accompanying the introduction of nuclear facilities into communities.[157] In Ontario the mere suggestion that government officials are making enquiries concerning the possibility of drilling test holes to determine the geological suitability of certain land sites for nuclear waste disposal is enough to mobilize citizen opposition. Government assurances that permanent nuclear waste "repositories will not be available for 15 to 25 years"[158] and ominous warnings that "In the meantime, the irradiated fuel will continue to accumulate," aren't much help.[159] One begins to wonder what sorts of jackasses set such technological nightmares in motion.

(9) The vision of limitless energy only feeds the forces of "extravagance and waste," driving North Americans farther down the road to mindless materialism.[160] (10) Future generations are being saddled with genetically induced disabilities, technological systems and social structures that they may find highly objectionable, if not intolerable.[161] (11) Some people in this and previous generations, since the introduction of nuclear power, are or have been typically exposed to more than a fair share of the mortality and morbidity risks. For example, "Persons living within a 50-mile radius

of a reactor . . . bear a cancer and genetic damage risk up to as much as fifty times greater than that borne by the general . . . public."[162] Children, of course, are more susceptible than adults. For a given level of "total body radiation," a child may be "three to six times more likely than [an] adult to contract cancer . . . ."[163]

(12) Waste heat produced by nuclear plants may alter the earth's climate.[165] Such plants are supposed to produce "over 50% more waste heat than conventional systems in generating an equivalent usable power output."[165] (13) The temperatures of water bodies adjacent to nuclear reactors are typically heated above natural levels and occasionally abruptly cooled when reactors are shut down, creating hazards for the aquatic life and its dependents. At certain critical temperatures "a species may exhibit locomotor disfunction or become disoriented thus becoming more susceptible to more temperature tolerant predators."[166] According to an OECD report,

> "Power stations take water from rivers, lakes and sea coasts, use it for cooling, and then they return it at a higher temperature. The warming of the waters that results leads the levels of dissolved oxygen to fall. This in turn affects plants and fish adversely and reduces the capability of water systems to assimilate organic compounds particularly in summer. Power stations can also create thermal barriers in estuaries that interfere with the migration of fish and with their spawning. Where the number of power stations is increasing, overloading of the cooling capacity of water bodies can occur."[167]

(14) The centralization of power centers in nuclear reactors tends to increase dense urbanization in order to make the most efficient use of the available energy.[168] The "cost of transmission and distribution" of electricity is supposed to be "in excess of 50% of the total cost at the point of end use."[169]

(15) Worst of all, there has not been and, in the near future, there will not be a satisfactory solution to the problem of nuclear waste management. Aspects of this anomaly have already been touched upon in previous points, but more should be said. In particular, it should be mentioned that, in the United States at least, over 90% of the accumulated nuclear waste is from weapons programs that are typically shrouded in secrecy.[170] So even if all the waste from civilian installations were perfectly managed, there would be no assurance that most of the material was being well-managed. According to a report in *Science*, in 1979 "More than a quarter-million cubic meters of liquid radioactive wastes, a volume equivalent to that of about 200 olympic swimming pools, are now being held at government installations awaiting final disposal."[171]

Because plutonium is a fissionable waste product, it is in principle recyclable as fuel. However, so far no reprocessing plants have worked out.[172] At this point in time (July, 1980), there are apparently no operating commercial fuel reprocessing plants in North America. The authors of a Department of Energy, Mines and Resources report said in 1977 that "We feel strongly ... that no commercial fuel processing plant should be approved in Canada until, inter alia, fully satisfactory methods for dealing with the radioactive wastes have been developed."[173] Nevertheless, and in conclusion, those authors said "We see no reason why the disposal problem need delay the country's nuclear power program. But there is great urgency in testing these conclusions."[174] Taken together these two sentences seem to mean that the authors of the report have no serious doubts about the decision to go ahead with Canada's nuclear power program although they have serious doubts about the reliability, validity or wisdom of this decision. Again, one really does begin to wonder about the brains behind such pronouncements.

9. OIL

In one of the most carefully written treatises on the oil industry, Blair claimed that

"No other industry begins to offer the data problems that are presented by petroleum. Statistical time series are few and far between, and even those that appear to relate to the same subject often differ in their definitions, with the result that they can neither be combined nor compared. The financial statements of the integrated companies reveal next to nothing about profits in the industry's successive stages or in their operations outside petroleum. The use of the techniques of 'creative accounting,' particularly the revaluation of inventories, gives to the companies considerable leeway in understanding earnings compared to those of previous years."[175]

Other people were less restrained. Sampson wrote that

"Behind all the intricacies of specific gravities, premiums, discounts and buy-backs, many of the problems of oil have been crude, in both senses."[176]

Later in the same book he cited a passage from a former U.S. Secretary of the Interior, Harold Ickes, who wrote in his diary that

"An honest and scrupulous man in the oil business is so rare as to rank as a museum piece."[177]

Pratt claimed that the oil industry is "notorious for its misuse of statistics."[178]

Of course, the oil companies are not solely responsible for our data problems. According to Sampson,

"Since tax avoidance is the critical element in the oil companies' financial power, the role of the accountants has been specially critical. The firm of Price Waterhouse . . . has for long been the special favorite of the majors. In 1971, they were accountants in the U.S. for four of the majors: Exxon, Socal, Gulf and Shell. The oil accounting systems are intricate enough thoroughly to confuse any layman. When Price Waterhouse in 1973 produced a survey of the accounting practices in thirty oil companies it revealed such a variety that (in the words of Les Aspin, the Democratic congressman from Wisconsin) 'no serious students of business economics could adequately compare the relative financial positions of any two of the thirty corporations.' "[179]

Unfortunately, it's easier to charge companies with "tax avoidance" than it is to prove it. In testimony before the U.S. Senate Committee on Finance, Senators E. F. Kennedy and E. F. Hollings claimed that

"For large corporations, the tax rate specified in the Internal Revenue Code is 48%. But as the following table indicates, the average effective tax rate for some of America's largest oil companies is only about 5 to 6%."[180]

Federal Income Tax Rate Paid by Largest Oil Companies 1974

(Source: U.S. Oil Week Computations Based on Company Annual Reports and SEC [Securities and Exchange Commission] Reports)

	Percent		Percent
Exxon	6.5	Sun	13.2
Texaco	1.7	Union	6.4
Mobil	1.3	Cities Service	8.3
Socal	2.05	Getty	22.5
Standard Indiana	10.2	Marathon	22.5
Shell	21.6	Ashland	32.4
Gulf	1.2	Standard Oil	12.8
Arco	3.7	Kerr-McGee	23.8
Phillips	12.9	Amerada Hess	7.5
Conoco	8.2	Average	5.99

The research staff of the Committee on Finance was asked to prepare an "analysis of the information presented by Senators Kennedy and Hollings" and, among other things, reported the following.

"The staff attempted to obtain a copy of the publication of U.S. Oil Week which is cited as the source of information for the above table. The Library of Congress received its last issue of U.S. Oil Week in 1970. A 1968 copy of the publication revealed that it is a newsletter published by the Observer Publishing Company, now located in Arlington, Virginia. The publication appears to be directed to a readership composed mainly of 'small businessmen in petroleum marketing'. Reached in Arlington, a spokesman for

U.S. Oil Week stated that the information relied upon by Senators Kennedy and Hollings was probably 'taken from our June 1974 issue which is based mainly on 10K forms filed by major companies with the SEC'. The staff is attempting to obtain a copy of the June 1974 issue. In any event, it is impossible that the June 1974 issue of Oil Week could contain the Federal Income Tax rate paid by oil companies for the entire year of 1974.

Whatever the reliability of the sources of information on the taxes paid by oil companies which was presented by Senators Kennedy and Hollings, the computations appear to be based upon a misleading and distorting technique of taking total world-wide income of major oil companies and comparing that figure with taxes paid only to the U.S. Federal Government. This would seem to be the only way to reach a conclusion that 'the average effective tax rate for some of America's largest oil companies is only about 5% to 6%.' This is a misleading comparison for two reasons: (1) It suggests that oil companies owe taxes to the U.S. on their world-wide income, no matter where it is earned or whether it has any reasonable connection with the country at all, and (2) this approach is misleading because it ignores taxes paid to State and local governments within the U.S. A much fairer way to measure the tax burden of oil companies is to compare total taxes (excluding excise taxes at the pump) against total income.

The staff of the Committee on Finance carried out a comprehensive study of oil companies' profits on domestic and foreign income which was published by the Committee in December 1974."[181]

Table 13 summarizes the results of the Committee's study, updated in 1975. Notice, for example, that Exxon's effective tax rate is listed as 81.8% of its total income on T13, compared to 6.5% on the *U.S. Oil Week* table. I doubt that anyone knows exactly how much of the discrepancy between these figures is a result of "creative accounting" and "tax avoidance", and how much is a result of honest differences of opinion about very complicated matters. In principle, the elected officials of democratic nations can design and insist upon clean accounting systems, and citizens of such nations can insist upon responsible behaviour from their representatives. But so far we haven't managed to do such things.

Turning from socio-economic issues, Blair claimed that

"On the supply side the informational problem [is] compounded by the U.S. Geological Survey, *the* authoritative source of figures on domestic reserves, which, beginning in the mid-fifties, persisted for over a decade and a half in issuing wildly inflated estimates of the supply of petroleum ultimately recoverable in the United States."[182]

The U.S. Federal Trade Commission reminded us that, like aspirin and airlines, all crude oil is not the same. "One problem" the Commission said, "with measuring production in terms of barrels of oil is that crude oil recovered from different areas has different characteristics in terms of heat

content (in British Thermal Units) per gallon, its viscosity or ease of flowing, its levels of impurities such as sulfur, etc."[183]

Describing the situation in Canada, Laxer complained that

"It is the oil industry that has supplied the figures. Government agencies, established to regulate the industry, are forced to accede to the industry's assessments because these agencies have no independent means to make an overall estimate. That the National Energy Board has done little more than follow the petroleum industry from one set of production estimates to another is evident from the NEB's behaviour in 1973 and 1974. Far from regulating the industry, the NEB has ended up as a front office for it."[184]

Even Statistics Canada, which has no vested interest in the oil industry, has been found wanting. Urwick, Currie and Partners Ltd. found in 1974 that

"Statistics Canada numbers overstate domestic consumption of petroleum products, by a significant amount, because the refineries sell products to jobbers who in turn sell them to the United States. Many of the jobbers immediately export their products to the United States. This problem was particularly acute in 1973."[185]

Overstated Canadian domestic consumption figures for petroleum products are probably the least of our problems, though that doesn't make the figures unproblematic. In 1974 Canadian consumption of crude petroleum was put at about 86.6 million metric tons, compared to 602.8 million metric tons in the United States (T14). That is about 3.9 and 2.8 metric tons per person in Canada and the United States, respectively. There is no way to determine how much of the difference between these figures is a result of overstatement.

The production to consumption ratios for the two countries are a bit easier to interpret. Even with inflated consumption figures, the Canadian ratio was always bigger than the American ratio in the 1964–74 period (T14, C3). In the last six years of the period the Canadian ratio was above unity, but for all other years both countries operated with a crude petroleum deficit. By 1974, the Canadian ratio increased and the American ratio decreased 16% over 1964. Throughout the decade the wellhead price of crude oil was lower in Canada than in the United States.[186]

Tables 15 and 16 provide an overview of the ownership of North American crude oil production in 1970. The 20 largest American crude oil producers accounted for 60% of all the crude oil produced in the United States (T15). In Canada the top 21 producers accounted for 71% of the total Canadian product (T16). Thirteen of those producers were American firms and together they accounted for 58% of the total Canadian product.

I have already indicated some of the problems of determining the sifnificance of concentration levels (percentages of market dominance) for industries. Given the required caveats, the following figures are worth noticing. In 1970 in the United States, "the top 20 crude oil producers provided 69.0% of crude oil production, 87% of refinery runs, 76.3% of gasoline sales, and 56.4% of natural gas production."[187] In 1962 (the latest year for which the Federal Trade Commission had statistics in 1970) "20 large petroleum firms accounted for 79.9% of petroleum pipeline mileage and 81.6% of crude and refined oils received into pipeline systems."[188]

In 1974 about 6% of American oil needs were supplied by Canada, which represented about half of Canada's total oil production that year.[189] When the CIPO asked a national sample of Canadians in December 1973 if they thought "it would or would not be a good thing for Canada to adopt" a policy of charging "an additional 40¢ a barrel for crude oil exported to the United States," 63% thought it would be a good thing and only 16% thought not.[190] Fifty-four percent thought it would be a good thing to "restrict all exports of Canadian crude or refined oil and gas," compared to 29% who thought not.[191] Fifty-one percent opposed adopting "a system of gasoline rationing," while 34% thought such a system might be a good thing.[192] Fifty percent opposed the idea of allowing the "Canadian price of gas and oil to rise to encourage further development of Canadian energy resources," but 29% thought it would be a good thing.[193] Opposition seems to be warranted, since it's not clear that increasing the wealth of those who sell gas and oil (namely, the majors) does anything for those who do most of the exploration (namely, the independents). According to Senator L. Bentsen of Texas,

> "While independent producers with no retail outlets control only 27% of the Nation's present oil production, they drill over 85% of the exploratory wells; and even when offshore exploration, where independents operate at a serious disadvantage, is included, when only the continental United States is considered, that figure is 88% of the exploratory wells. The dominance of the independent exploratory effort is apparent at every depth of exploration. At the 12 000 to 15 000 foot range, they still drilled 70% of the exploratory wells. Even at the extreme depths of 20 000 feet, independents drilled more exploratory wells than major oil companies.
>
> . . . they are not just drilling wells. They are finding new reserves. Last year there were over 7000 more successful wells brought in than in 1973. Independent producers brought in almost 80% of those new wells. . . .
>
> Independents have no profits from sales of refined products and no means of passing on the higher burden resulting from loss of depletion. Independents rely heavily on outside risk capital to finance their exploratory activities. Without the benefits provided by the percentage depletion allowance, these funds will become increasingly unavailable, and force a substantial reduction in exploration budgets. Independents engage in the

higher risk operation of drilling in unproven areas as indicated by 88% of their production from discoveries in Texas, between 1967 and 1971 coming from previously unproven areas, while only 11% of major oil companies' production came from discoveries in unproven areas during the same period.

In short, the independents find the fields; the majors develop them. The independents take the big risks and the majors come in later, buying up the leases, to develop for their refineries and retail marketing. That has been the traditional pattern of the industry."[194]

In January 1974, 56% of a national sample of Americans expressed disapproval of gasoline rationing, while 34% favoured such a policy.[195] The following month these figures changed insignificantly to 53 and 37%, respectively.[196] There was, then, no significant difference between Canadian and American attitudes toward gasoline rationing in late 1973 and early 1974.

In February 1974, 75% of a national sample of Canadians said they approved of a "freeze on gas and oil prices . . . to extend until spring 1974."[197] Sixty-two percent approved of the "formation of a national petroleum corporation" and 74% approved of "large federal capital expenditures for research and development of alternative energy sources."[198] Clearly, by the end of our period Canadians were committed to the view that their Federal government had an important role to play in the field of energy development in general, and gas and oil development in particular.

10. NATURAL GAS

According to the report of the Environmental Policy Division of the Congressional Research Service of the U.S. Library of Congress,

"Of all the presently available fossil fuels, natural gas is the most pollution-free, the least expensive, the most versatile, and the most unobtrusively transported. It is also in very short supply."[199]

Testifying before the U.S. Senate Committee on Finance, the Senior Vice President of the American Gas Association proudly proclaimed that

"Natural gas is the cleanest fuel, with no environmental concerns. It does not pollute the air, land, or water. Finally, it is the most efficient form of energy, simply because it does not have to be transformed into electricity as does coal or oil. It does not have to be refined as does crude oil, and it is also the most efficient at the point of utilization."[200]

Of course, as we saw in Section 6, gas and oil *are* used to produce electricity. For example, 51% of the electricity produced for the region controlled by the Northeast Power Co-ordinating Council (F4, T8) comes from some mixture of gas and oil. Moreover, as suggested earlier, when electricity is

generated from natural gas or oil there is a "conversion efficiency" of about 30%.[201] So using these fuels to produce electricity really means throwing away roughly two Btu's for every one used constructively. Imagine throwing away two steaks, automobiles or practically anything else for every one used constructively, and you begin to get a feeling for this aspect of the energetic wonderland North Americans are living in. Clearly, the current demand for such energy is only remotely related to the energy actually required to produce the same level of living.

The complaint that is most frequently made about data on natural gas is similar to one made about data on oil. It is simply that governments don't have any source of statistics on oil and gas that is independent of the producing companies.[202] It is hardly surprising that this problem is shared by oil and gas statistics, since "the common geological base" of oil and gas "dictate[s] that they be produced by the same firms."[203] Using the term 'petroleum' broadly to cover both natural gas and crude oil, the U.S. Federal Trade Commission reported that in 1970 "Eighteen of the 20 largest petroleum producers are among the top 20 firms in both oil and gas production."[204] Further, "As a group, the 20 top petroleum producers account for approximately 67% of oil production and 60% of natural gas production."[205]

In 1974, Canadians consumed about 416 thousand trillion calories of natural gas, while Americans consumed about 5600 thousand trillion calories (T17). That's about 18.5 billion calories per Canadian and 26.6 billion calories per American. Using the United Nations' assumption that a gram of coal is worth about 7000 calories,[206] Canadians consumed about 2.6 metric tons of coal equivalent of energy from natural gas, while Americans consumed about 3.7 metric tons.

Americans operated with a natural gas deficit throughout the decade, while Canadians never had a deficit (T17, C4). In the final year of our period, the American production to consumption ratio for natural gas was 0.96, and the Canadian ratio was 1.83. That represented a two percent decrease over 1964 for the United States and a one percent decrease for Canada.

In 1970, about 4% of American gas needs were supplied by Canada, and that was "approximately 35% of Canada's total gas production."[207]

The top 19 natural gas producers in Canada in 1970 accounted for 66% of the total Canadian production (T18). Only four of the 19 firms were owned by Canadians (Central-Del Rio, Dome Petroleum, Home Oil and Husky Oil), and these four accounted for 8.7% of total production. Because Canadian production represented less than 10% of American production and "the bulk of this production is controlled by U.S. firms with roughly

equivalent positions in the [American] market,"[208] the FTC constructed a single table listing the top 20 natural gas producers in North America (T19). Toegether these firms accounted for 57.5% of the total production in 1970.

11. COAL

At one of the Hearings of the U.S. Senate Committee on Finance in 1975, the following exchange took place between Senator H. E. Talmadge and the President of the National Coal Association, C. E. Bagge.

"Senator Talmadge: I have seen various statements that this Nation has anywhere from 300 to 800 years supply of coal. Which is accurate?

Mr. Bagge: Which is accurate?

Senator Talmadge: Yes, how much coal?

Mr. Bagge: The answer to that, Senator, is that we don't really know how much coal we have got. We say there are 434 billion tons of coal in demonstrated coal reserve base in the United States, and 50% of that we say is recoverable with the present technology. That would take us to 300 or 400 years. But then the geologists tell us in addition to the demonstrated coal reserve base, we have got at least twice that.

And, of course, if we employ the mining technologies that they do in Europe, where they have to go two and three times as deep, we do not go that deep in the United States, we do not go for all of those thin seams, or seams that are difficult to mine, but we are talking about something that potentially could be enough, at the present rate of use, for 800 years, in my opinion.

The Chairman: May I interject at that moment, because I want to get this straight; you are presently providing about 18% of our energy needs with coal and at that rate we have enough for 800 years.

But, if you were providing 100% of our present energy needs with coal, you would have to divide that 800 by about 5, would you not?

Mr. Bagge: Exactly. That is why I said under present levels of production, ..."[209]

This exchange is instructive in at least three respects. First, it illustrates the fact that government officials don't have access to assessments of coal reserves that are independent of producing firms. Second, it illustrates the fact that what is regarded as a *coal* reserve depends in large measure on what technology is used to get the coal. The basic recovery techniques are surface and underground mining. With the latter technique, in the United States at least, about half of the discovered coal is left in the ground. "The rest" according to Osborn, "is left chiefly as pillars to support the roof – for a few years. Eventually the pillars give way, the roof caves, the surface subsides, and the coal left becomes very difficult to ever recover."[210]

With surface or strip mining, virtually all of the discovered coal is recoverable. This is also the safest and least expensive recovery technique.[211]

Although it only accounted for about 44% of total American coal production in 1973, it accounted for about 79% of Canadian coal production in 1972.[212] It's main drawbacks are environmental. U.S. Representative K. Hechler told the Senate Committee on Interior and Insular Affairs that with strip mining

"Watertables are destroyed, depriving the earth of its channels of nourishment. The delicate surface fabric of life supporting earth is cast to the bottom. Deep strata of rock and shale are pulverized and exposed to the elements, where they will leach acids and toxic minerals into the surrounding streams for generations. Mountains, now unstable, crack, slip and slide. Rains wash mud, sand and toxic substances down into the streams and rivers, filling their channels and poisoning their waters."[213]

A. T. Wright of the Wilderness Society told the Committee that "reclamation is at best a myth and at worst a hoax if we delude ourselves into believing that we can reestablish anything but a shaky monoculture on strip-mined areas."[214]

The third point illustrated by the Talmadge-Bagge exchange is that what is regarded as an *energy* reserve depends on what technology is used to get the energy. Because coal is relatively abundant in the United States, there is considerable support for extracting energy from coal through thermal electric plants, gasification and liquifaction.[215] We have already seen that there is a substantial energy loss when coal, gas or oil are converted to electricity. When coal is converted to gas or oil, at least 25% of the energy in the coal is lost.[216] Senator P. J. Fannin told the U.S. Senate Committee on Finance that he received a report claiming that "55% of the Btu in the coal would be lost if they went from coal to the gasification, and then [he] was told more recently that if you take into consideration all of the elements involved with the recoveries of the byproducts from the coal, that it would bring it up to as high as 71%."[217] Besides wasting energy, coal gasification and liquifaction involve hazardous effects on human health and environmental quality that are still beyond rigorous assessment.[218]

Most of the research related to the extraction of energy from coal has been concerned with comparing the generation of electricity by burning coal with that of fissioning uranium. The results so far have been disturbing. For example, although nuclear wastes represent a very serious set of unresolved problems, the report of the Canadian Department of Energy, Mines and Resources asserted that

" . . . dangerous wastes are not unique to the nuclear power industry. The major fuel alternative to uranium-coal-generates and releases large quantities of toxic wastes. The ash from burning coal contains radioactive nuclides, including radium-226, which

presents about the same hazards to man as plutonium-239. In addition, the ash contains many other toxic elements. . . . Several estimates of the number of premature deaths caused by the entire coal fuel cycle place the number as much higher than that considered as possible for a uranium fuel cycle."[219]

Hohenemser, Kasperson and Kates compared the three basic electric power technologies for

" . . . four classes of hazards: (i) routine occupational hazards, such as those of mining; (ii) routine population hazards, such as the inhalation of pollutants; (iii) general environmental degradation, such as destruction of cropland; and (iv) catastrophic hazards, such as massive release of radioactivity and dam failures."[220]

And they concluded that

" . . . the quantified risks, based on available information, are much larger for coal and hydroelectric than for nuclear power."[221]

Inhaber attempted a "risk evaluation" of "eleven methods of generating electricity or energy," with five "conventional sources" (coal, oil, natural gas, nuclear, and hydroelectricity) and six "nonconventional sources" (solar thermal electric, solar photovoltaic, solar space heating, methanol, wind and ocean thermal).[222] His general conclusion was that "the risk to human health from nonconventional sources can be as high as, or even higher than, that of conventional sources."[223] But for our purposes the interesting conclusion he reached was that the use of coal to generate electricity presents greater risks than the use of nuclear fission.

At least three researchers took the trouble to challenge Inhaber's views publicly and in detail.[224] When I wrote to the latter to find out what he thought about the charges, he replied,

"I have gone over each criticism made, and found that most were invalid. Of those that were valid, they did not change the overall rankings of the eleven systems considered, i.e., coal and oil with the highest risk per unit of energy output, natural gas and nuclear with the lowest, and the other seven systems (mostly non-conventional or 'renewable') in the middle. . . . A recent paper by Hoy of Oak Ridge National Laboratory in the United States has confirmed, generally speaking, my results."[225]

Nothing comes easy but humility in the face of one's ignorance and uncertainty concerning the correct inferences to be drawn about the relative hazards of producing electricity from burning coal and fissioning uranium. Even if one accepts the conclusion (as I'm inclinded to) that, relative to the range of hazards considered in the coal-versus-nuclear-fission studies

cited above, coal is more dangerous, it does not follow that relative to a broader range of hazards coal is more dangerous. Moreover, it seems to me that when one compares the continued use and development of coal versus nuclear power relative to the broader range of hazards listed above in Section 8, coal power looks like the lesser of two evils.

In the presence of the preceding sentence, the following sentence might be comforting to Americans. Throughout the 1964–74 decade the United States had a coal production to consumption ratio greater than one, while Canada always ran a severe deficit (T20, C5). In 1974 the American ratio was 1.09 and the Canadian ratio was 0.82, which represented a 3.5% decrease over 1964 for the United States and a 105% increase for Canada. On a per capita basis, Americans consumed about 2.4 metric tons of coal in 1974, and Canadians consumed nearly one.

In the United States in 1970, the top 20 coal producers accounted for 56% of the total production (T4). Twenty percent of all coal production was controlled by petroleum companies.[226] Finally, taking all petroleum and coal producing firms together, in 1974 they had the highest annual rate of profit on stockholders' equity, 21%, of all American manufacturing industries (T21).

12. ALTERNATIVE ENERGY SOURCES

By now it will be easy to appreciate Commoner's folksy ecological law that "there is no such thing as a free lunch." So far as energy production and consumption are concerned, we are always confronted by trade-offs among barely (occasionally wildly) quantifiable benefits and costs. The results of Inhaber's investigations suggest that this is as true for nonconventional as for conventional sources of energy. In order to provide a thorough analysis of only the most popular types of potential nonconventional energy sources, I would have to put a severe kink in what is already a pretty wavey story line. However, I think it's possible to provide a brief overview of some of the main alternatives without destroying the flow of my narrative, and the additional information will enrich the perspective from which all energy problems are viewed.

The term 'biomass' is used to designate living matter and its fairly immediate residue.[227] The phrase "fairly immediate" is an imprecise but useful means of excluding conventional fossil fuels (coal, oil and gas) which are the remains of temporally distant living matter. To include biomass under the general rubric of nonconventional energy sources is a bit misleading, since everyone who has ever burned wood to get heat has made use of one

type of biomass. In fact, in 1970 an estimated 46% of the total world harvest of roundwood (raw timber) was used as fuel.[228] Other types of biomass include agricultural products such as grain,[229] sugarcane[230] and pineapples[231] used to produce fuel alcohol, the waste material resulting from silviculture and agriculture, and the garbage resulting from human consumption.[232]

Estimates of the amount of energy producible from biomass in the United States range from the optimistic view that "an austere but satisfactory economy based on trees as a principle energy source" could be maintained[233] to the more conservative view that about "25% of the nation's annual energy needs" could be provided by biomass.[234] In Canada estimates of the amount of annual national energy needs that might be provided by biomass range from 19 to 33%.[235] The report of the Department of Energy, Mines and Resources that had as "one of [its] most important functions" the estimate of "the maximum potential amount of energy that could be technically produced from forest biomass" emphasized that "the data necessary to make any solid approximations are not available."[236] Nevertheless, it produced an estimate that was a bit under the maximum figure (33%) cited above.[237]

The advantages of increased use of biomass in North America include its abundance in one form or another across the whole continent,[238] its relative renewability,[239] its relatively low ash and sulfur content[240] and its relatively stabile availability.[241] On the negative side, "the overall conversion efficiency for the generation of electricity from wood has been estimated to be 25%,"[242] and "wood requires about five times the storage volume of oil or coal on an energy basis."[243] According to Sarkanen,

> "On a dry weight basis, the Btu values of wood range from 8000 to 9000 in comparison with 18 000 for No.6 fuel oil, 13 500 for bituminous coal, and 18 500 for natural gas. However, in contrast to fossil fuels, freshly cut wood has a high moisture content (40 to 150% on a dry weight basis), which reduces the heat value by as much as 20%. Thus, the net heat value of freshly cut wood is usually of the order 2500 to 3500 Btu per pound. Similar heat values are valid for agricultural residues as well."[244]

Further disadvantages include the probable use of increased amounts of herbicide, insecticide, fungicide, fertilizer and fresh water, with potentially disturbing environmental consequences.[245] Increased mechanization of silviculture and agriculture will bring increased levels of noise.[246] The mortality rate for forestry workers is second only to that of miners, and the former would probably increase with increased use of biomass as an energy source.[247] Finally, insofar as waste biomass is used, one may find oneself engaged in a self-defeating activity. In order to institutionalize good waste management

practices, one may find oneself institutionalizing wasteful practices as well; which would be like allowing people to get fat in order to get them to watch their weight.

Next to getting heat from burning wood, nothing could be more familiar than getting heat from standing in the sun. Indeed, the direct use of solar energy for heating is still probably the most efficient way to tap the enormous energy of the sun. "In its simplest terms," Cockshutt wrote, "a solar heating system comprises a solar collector, a heat storage unit, and a conventional heat distribution system, plus appropriate back-up heating."[248]

The advantages of using and developing solar energy include its distribution across the continent, its abundance and its inexhaustibility.[249] Insofar as we can tap the sun directly, we avoid both the waste and the pollution associated with other energy sources.[250] The disadvantages include the costs in money, material and, at bottom, energy to build the collectors, storage units, distribution systems and so on.[251] While it is often assumed that solar energy systems might be used in conjunction with conventional electric systems, Asbury and Mueller argued that the two types of systems "represent a poor technological match."[252] "The basic problem" they claimed, "is that both technologies are very capital intensive."[253] The potential incompatibility was summarized by the Department of Energy, Mines and Resources, following an Ontario Hydro report.

> "First, the utility must have sufficient capacity to meet the peak demands, and the capacity requirements of the electric utility are therefore not reduced if solar heating systems are installed within a community. Second, the utility's load factor for this installed capacity is lower than if there were no solar systems, and the cost of electric power will therefore be higher. Finally, the total capital investment necessary to meet the energy needs (homeowner and utility) is greater than for centralized systems, by the additional cost of the solar systems."[254]

Wind power is familiar to everyone. If properly harnessed, Gustavson estimated that it could produce energy equivalent to "roughly 75% of the current [1979] national total energy" consumed in the United States.[255] Basically all that's required is a wind turbine attached to a generator in order to produce electricity. Such turbines don't have any associated "radioactive, chemical or thermal pollution."[256] But they also don't work unless the wind blows, and the wind doesn't always blow.[257] So it would only pay to adopt wind energy systems in especially windy areas, and even in such areas there would have to be some sort of storage and back-up systems. So far wind energy systems have been too expensive to operate on a large scale. If their

capital costs became tolerable, there might be problems of "visual pollution, noise, microwave interference, and even bird kills."[258]

The energy captured in the earth's oceans is virtually unlimited. Theoretically it may be harnessed mechanically using waves, swell, tides and currents, chemically using salinity gradients and biomass, and thermally using temperature gradients.[259] The possibility of getting tidal power has been explored at the Bay of Fundy off Nova Scotia.[260] The possibility of producing usable energy from temperature gradients (i.e. from the differences between the temperatures of the ocean at different depths) was explored by Othmer and Roels.[261] They claimed that if the relatively warm Gulf Stream water were "discharged to water colder by 25 °C, [it] could generate more than 75 times the entire electric power produced in all of the United States."[262] While it is technically possible to draw cold water from the depths of the ocean to meet warmer surface water, so far it has not appeared to be economically feasible. Moreover, the environmental consequences of such ocean management are largely unknown.

In some areas it is possible to generate electricity by using the steam from geothermal fields, e.g., at The Geysers near San Francisco.[263] So far as I know, there are no operating geothermal plants in Canada.

Finally, some mention should be made of nuclear fusion. When two light atoms (e.g., deuterium or tritium) are combined to form a heavier atom, there is an enormous release of energy. That's what happens with the hydrogen bomb. If nuclear fusion can be controlled, there will be a virtually unlimited supply of fuel.[264] Compared to nuclear fission, fusion is supposed to involve fewer potential hazards.[265] However, according to Holdren, "It will be slow in coming – probably making no substantial contribution to the world energy supply until at least two decades into the next century – and it is likely to be expensive; but it is interesting anyway because of the likelihood it can fit the demanding niche determined by the nature of the energy problem in the long term."[266]

13. MATERIALS

Most of the last nine sections (4–12) have been concerned with an examination of North American energy problems in the 1964–74 period. In the following five sections (13–17) I will examine materials problems. Since the discussion of energy clearly involved a discussion of material used to obtain energy (e.g., uranium, coal, oil), in a broad sense of the term, I have been writing about materials all the time. So far I have considered materials

used primarily for fuel. Now I will consider materials used to manufacture other things. When fuel or energy materials are used to manufacture other things, the material is said to be used as a feedstock. For example, about four percent of the crude petroleum and natural gas produced in the United States is used as feedstock for the petrochemical industry.[267]

"Materials" Huddle wrote, "have a 'life cycle' from extraction to refinement to processing to fabrication to use in finished products and therefore to discard or recycling. This sequence is called the 'materials cycle'."[268] Each step in the life cycle of any material has its own story, most of which will be ignored here. Generally I will merely present production and consumption statistics, with some background and explanatory remarks.

In 1952 the President's Materials Policy Commission (the Paley Commission) reviewed the American situation and

> " . . . urged four national measures: (i) statistics on the relation of the supply of materials to the demand should be carefully maintained and closely watched; (ii) resource conservation and development should be pressed, with emphasis on new materials technology in substitute materials; (iii) a nongovernmental institute should be established to monitor the state of materials supply and demand; and (iv) a new governmental institution close to the President should be established to formulate and direct national materials policy."[269]

Twenty-two years later the U.S. General Accounting Office "severely criticized the Administration for failing, during the 20-year interval after the Paley Commission report, to implement its recommendations."[270]

About the time the General Accounting Office was rebuking the U.S. Administration, a joint report of "federal and provincial Ministers responsible for mineral policy" was released called *Towards a Mineral Policy for Canada: Opportunities for Choice.*[271] In the interests of pursuing three broad national objectives (a good quality of life, sovereignty and unity, economic growth and development), the report distinquished four broad policy options.[272] These were: (1) "Continue, as in past decades, to encourage *maximum mineral production*. (2) Encourage *economic diversification and growth* through increased mineral processing and mineral-based manufacturing in Canada. (3) Obtain the highest possible *net financial returns* to Canadians from minerals. (4) *Conserve mineral resources* for long-term domestic requirements."[273] The authors of the report thought that some aspects of the four options could be combined, but that it would be impossible to "pursue the main elements of all four options simultaneously."[274] Given the looseness of the language used in specifying the options and the willingness of policy

makers to combine aspects of one with another, I suspect that virtually anything the government does can be regarded as consistent with something in the four-option package. That can be viewed as good planning, or good public relations in the absence of a clue as to what to do next. In fact, the second option seems to be the darling of most official reports, with options (1) and (3) pursued fairly vigorously but without official fanfare.[275]

By 1971, 51% of the nonfuel mineral producing firms in Canada were controlled by non-residents. That was an increase of 5% over 1965.[276] Fifty-nine percent of nonmetallic mineral processing firms were controlled by non-residents in 1971, up 60% from 1965.[277] If the aim is "diversification and growth", we seem to have been going about it in a peculiar way.

The standard problems of obtaining reliable estimates of resources and reserves in the mineral industry tend to be magnified for nonfuel minerals due to the relatively greater possibilities of functional substitution. Bethel and Schreuder represented a majority view when they wrote that "There are very few industrial materials for which another material is not technically substitutable. Furthermore, there are few industrial materials for which there is only one substitution option."[278] This is *material* substitution. *Functional* substitution is illustrated by such things as the change from vacuum tubes to transistors, and from calculating machines to integrated circuits.

> "In these substitutions, a completely different approach to performing a needed function is found. For example, adhesives can be used instead of nuts and bolts for joining. Jet engines replace piston engines and propellers in aircraft. Telephones can replace mails for transmitting information. Nuclear reactors replace boilers fired by fossil fuels. Functional substitutions can lead to the revision of consumption patterns for materials and energy and can inspire the creation of entirely new industries.
>
> The transistor, for example, has led to technological development of computers, missle-control systems, and a broad range of industrial, medical, and leisure products. And in nearly every case, the substitution of solid state electronics for older techniques appears to have led to considerable savings in the amounts of material needed for manufacture and the energy required to operate the equipment."[279]

The possibility of functional sustitution creates difficulties for the estimation of future demands and supplies. Current demand and supply figures, as reflected in consumption and production figures, do not provide an accurate picture of present shortages. After all, what one consumes might be far less than what one would like to consume.

In March 1974, the Permanent Subcommittee on Investigations of the U.S. Senate Committee on Government Operations sent a questionnaire to "the 500 largest American industries" in order to measure the amount of

shortages of primary and secondary materials.[280] The distinction is not very neat or crucial for our purposes. The materials covered a wide variety of things including, for example, as primary, aluminum, cement, glass, iron, lumber, milk, rubber, steel, sugar, and as secondary, electronic parts, fertilizer, insulation, paint, paper, plastics, roofing, materials, textiles, wire and cable.[281] Two hundred and fifty-eight (52%) of the companies responded,[282] and only 13 (5%) "reported that (1) they had no shortages of any basic materials or (2) they had shortages but did not specify the materials."[283] Some of the details of the responses will be cited below with the discussion of specific materials.

14. SELECTED METALS

Table 22 gives an overview of the percentage distribution of production and consumption figures for six metals for which comparable statistics were available. The six metals are iron ore, zinc, aluminum, copper, nickel and magnesium. In 1974, iron ore represented 93% of the total production for the six metals in Canada and the United States. It represented about 95% of Canadian and 94% of American consumption of the six metals.

Americans consumed about 165 million short tons in 1974, compared to about 15 million consumed by Canadians (T23). That represented a 7% increase over 1964 for the United States and a 47% increase for Canada. The Canadian production to consumption ratio for this set of metals was 3.6 in 1974, while the American ratio was 0.6 (T23, C6).

Since production to consumption ratios less than unity indicate a deficit for this selected set of metals, I'm inclined to regard these ratios as positive social indicators. The reasoning here is as it was in the case of energy ratios (Section 4). Ratios greater than unity do not show that there are no shortages or that there is complete self-reliance, but ratios less than unity do show that there is not self-reliance. Self-reliance in materials, as in anything else, is not a supreme good, but it is still good. Moreover, if all other things were roughly equal, it would be better to live in a country without than with materials deficits. In case it's not obvious, generally speaking the greater the scarcity (deficits), the greater the price and the likelihood of inequitable distribution. Accordingly, Canada makes 11 points for its superior stock values on this indicator, leaving nothing for the United States. For its superior annual flows Canada makes 3 points and the United States makes 5.

Tables 24 to 30 give detailed statistics for the six selected metals and mercury. A cursory inspection of these tables indicates that, with the exception

of magnesium, the United States had a production to consumption ratio less than unity for every material every year in the 1964 to 1974 decade. Canada had only three years when it had a deficit, namely, 1964 – mercury, 1973 and 1974 – magnesium.

Rather than systematically exploring the circumstances surrounding the production and consumption of all these minerals or ignoring such circumstances altogether, I am going to briefly mention some aspects that are especially relevant to the energy-materials-pollution triad and the quality of North American life.

It has already been noted that iron ore dominates the production and consumption scene for the six selected metals. In the Senate Permanent Subcommittee's survey, 29 companies (11%) reported difficulty in obtaining iron and iron products.[284] In the 1970 to 1973 period, an annual average of 46% of the total Canadian production was exported to the United States, and that represented 16% of the latter's total consumption.[285] Although as a rule increased profits tend to accompany increased processing of any raw material, processing is expensive. For example,

> " . . . to mine and beneficiate 1 ton of iron from presently used magnetic taconite ores requires about 5% as much energy as is required for the total production of steel from ore. Thus, the overall energy required is not very sensitive to the grade of ore until the ore becomes extremely dilute, and this will never happen for the inexhaustible metals."[286]

Thus, even if it is granted that "the U.S. steel industry wastes a third of the energy it buys,"[287] much more energy is required to process than to merely mine iron ore. It's also the case that the total fabrication of things in one material can be enormously more costly than their fabrication in another material. For example, "steel floor joists require 50 times as much energy as their wood counterparts."[288] Moreover, "aluminum, which has increasingly displaced steel and lumber as a construction material, requires for its production about 15 times more fuel energy than steel and about 150 times more fuel energy than lumber."[289]

Since North American big cities tend to be laced with big buildings that require steel and aluminum, it's apparent that such a style of living is extremely costly in energy. Of course, it also takes energy to house everyone side-by-side in single frame houses, and to move them about from one place to another. The lesson to be learned now is not that there's no free lunch, which you already know, but that there are choices to be made. More

precisely, it's important to appreciate the fact that cities can be planned with energy trade-offs roughly quantified and debated. Similarly, national economies can be planned with material and energy trade-offs in full view. What's more, "Improvement [in the quality of our lives] may depend largely on having a range of choices available, and on the ability to make choices with a balanced perspective of immediate and long-term consequences."[290]

Seventy-four companies (29%) in the Senate Permanent Subcommittee's survey reported aluminum supply problems.[291] Although Canada always had a production to consumption ratio greater than one, "all aluminum produced in Canada is smelted from imported ores"[292] (T25). Moreover, the 1974 production to consumption ratio of 2.6 represented a 46% decrease over 1964. The United States always had a deficit, but its 1974 figure was only one percent lower than its 1964 figure. About 20% of American aluminum was produced from recycled scrap metal in 1975.[293] Since the production of aluminum from scrap metal requires less than 5% of the energy required to produce it from ore, there are substantial savings involved in recycling this metal.[294]

Given all the discussion in this book about American dominance of Canadians, it is instructive to notice some of the latter's behaviour concerning a smaller country, namely, Jamaica. According to Stewart,

> "The Aluminum Company of Canada, the largest foreign enterprise in the Caribbean, takes great pride in its behaviour as a corporate citizen there, but when the company president was questioned by a committee of the Canadian Senate in 1970, he sounded pretty much like Harold Geneen of ITT discussing the firm's good works in Canada. No, the company does no research in the West Indies; no, there were no shares, and no intention to offer shares, to the locals, and no, the company did not plan to use local help at the upper echelons: 'We feel somewhat handicapped by the regulations which require the use of nationals in management positions if they are available.'
>
> The company, as of the time of this testimony, owned 48 000 acres of land in Jamaica, and its bauxite operation, worth $175 million – the largest single investment on the island – is used to extract the raw material, which is irreplaceable, ship it off to Canada for processing, and sell back finished products at extravagant prices. The Jamaicans don't like the process any better than we like the exploitation of our oil, pulp and paper, or iron ore. They are now moving to demand a greater share of the profits through abrupt royalty hikes."[295]

The apparent moral of this story is that Canadians can be as self-serving as anyone else. The deeper moral is that it's a mistake to think of self-serving behaviour as a *national* characteristic. It's a *human* characteristic that precedes nation-states by hundreds of years.

Sixty-two companies (24%) in the Senate Permanent Subcommittee's

survey reported copper shortages.[296] The 1974 Canadian production to consumption ratio for this metal was 3.4, compared to 0.73 for the United States (T26). That represented a 41% increase over 1964 for Canada, and a 7% increase for the United States. Copper provides an excellent example of how new technology "created resources where none existed."[297] Cook claimed that

"In 1900 the lowest grade of copper ore economically minable was about 3%; today the economic cutoff has fallen to about 0.35%; at that grade each ton of refined copper produced requires the breaking, transport, and milling of almost 300 tons of rock and, in addition, the removal of perhaps an equal amount of waste or barren rock. A great deal of energy – about 26 000 kilowatt-hours, the equivalent of the energy in about 4 metric tons of Wyoming coal – is required to produce a metric ton of copper today, but the cost of that energy is still low compared to the cost of supporting the equivalent in men and mules."[298]

The last metal meriting a few remarks is mercury. This metal was not even mentioned in the Senate Subcommittee's survey, perhaps because "Acceptable alternatives are now known for all the major uses of mercury . . . ."[299] The 1974 Canadian production to consumption ratio for this metal was nearly 13, compared to 0.04 in the United States (T27).

The most widely publicized side effect of the production and consumption of mercury is Minamata disease. As a result of natural environmental processes, waste metallic mercury becomes the toxic methylmercury.[300] Continued dumping of mercury into Minamata Bay by a chemical firm led to the poisoning of over 1500 people and the death of over 240 more.[301] The OECD reported that "While the chemical plant has been in production since 1932 the disease was not identified until 1946 and although the toxic discharges were halted in 1960, their effects are still being registered."[302]

Brinkhurst and Chant claimed that "Analyses of food in supermarkets in Toronto indicate that mercury can be found in almost any food," not just in fish.[303] That's not very surprising when the variety of waste mercury sources is recognized. The U.S. Council on Environmental Quality reported that

"Aside from its natural distribution, mercury contamination arises directly from municipal waste disposal, agricultural activities, chlor-alkali, petrochemical, steel, and other industrial sources, mining and smelting operations, and many other sources. In addition, mercury is a volatile metal that becomes released to the atmosphere in significant quantities during the combustion of fossil fuels and the heating of many other mercury-containing chemicals. This atmospheric mercury, in particulate and gaseous forms, becomes dispersed by winds and deposited on the land through precipitation and dry fallout."[304]

15. CHEMICALS

Although few materials are used without any processing or finishing work, some materials are clearly classifiable as manufactured products rather than natural resources. All the chemical products referred to in Tables 32–44 are manufactured. It was impossible to find production and consumption statistics in measured quantities of the chemicals themselves. Instead we have to get along with export and import statistics in dollar values. For comparative purposes practically nothing is lost by considering export to import ratios instead of production to consumption ratios.

The U.S. Council on Environmental Quality described the American chemical industry as "profitable, innovative and competitive" and generally not facing "as serious economic problems as . . . many other industries."[305] Contrary to the likely prevailing North American opinion, American firms do not dominate the chemical industry. The top 3 of the top 10 international chemical conpanies (in total sales) in 1973 were German (T31). The top American company, E. I. DuPont de Nemours, had the fourth highest sales figure. No Canadian firms made the top 10.

The main problem the U.S. Council recognized for the industry was that

> "Hundreds of new compounds are introduced into commerce each year, before their potentially harmful effects have been fully assessed and even as new problems are uncovered involving chemicals in wide use. . . .
>
> A lack of testing, access to information, and communication has put the government and the scientific community in a reactive posture toward these problems. In some cases, no federal authorities exist to remedy problems once they are discovered."[306]

This is reminiscent of the problems reviewed in Volumn I, Chapter 3.11 concerning food additives, nutrition and safety, and the limitations of regulative agencies in Canada and the United States. With about 250 000 new chemical compounds being synthesized every year, and from 300 to 500 being put on the market,[307] it's easy to see how agencies can fall behind.

The potential profits from chemical technology are vast. The Chairman of DuPont's Board of Directors pointed out that a barrel of oil worth $12 to $15 in 1978 was worth five times as much when it was "synthesized into polymers such as the large-volume plastics."[308] It was worth 10 times as much "made into fibers, and 100 times as much if converted into agricultural chemicals or photosensitive materials such as x-ray film."[309] What is perhaps even more remarkable is the fact that the use of chemical synthetics is sometimes more energy efficient than the use of some traditional natural products.

For example, "Manufacture of an all-cotton shirt requires 88% more energy than that required for a shirt containing a blend of 65% polyester and 35% cotton."[310]

In 1974, the United States exported about 6.4 billion (1964 U.S.) dollars worth of chemical products, compared to nearly 800 million dollars worth exported by Canada (T32). That was an increase over 1966 of 127% for the former and 97% for the latter.[311]

The value of chemical products imported into the United States in 1974 was 2.7 billion dollars, compared to nearly 1.4 billion for Canada (T32). That represented an increase over 1966 of 181% for the United States and 156% for Canada.

As the preceding figures suggest, the United States typically had an export to import ratio greater than one for chemical products, while Canada's ratio was typically less than one (T33, C7). In 1974, for example, the American ratio was 2.37 and the Canadian ratio was 0.56. As in the case of production to consumption ratios, export to import ratios seem to be plausible candidates as positive social indicators. Ratio's less than unity indicate dependence on other countries which, if all other things were equal, would be avoided. Thus, the United States makes 9 points for its superior ratio stock values in the 1966–74 period and Canada makes nothing. For its superior ratio flows (annual percent changes) the United States makes 3 points and Canada makes 5.

Canada's major chemical export in 1974 was fertilizer, which, I suppose, would be high on anyone's list of things that might be shipped elsewhere. It accounted for 35% of the total value of exported chemical products (T34). The major American chemical export that year was the group of organic chemicals, accounting for 25% of the total value of exported chemical products. The major Canadian chemical import was the group of plastic materials (24% of the total value of imported chemical products), and the major American import was again the group of organic chemicals (32% of the total value of imported chemical products) (T34).

One of the chemical groups listed in Table 34 merits special attention, namely that of insecticides, fungicides and disinfectants. This group represents the third American and the fourth Canadian major chemical export. It's also the fifth American and the third Canadian major chemical import. The American export to import ratio for this group of chemicals was 4.55 in 1974, compared to 0.20 for Canada (T35). In both cases there was a decrease over the 1966 ratios, 24% for the United States and 46% for Canada.

By 1973, only 4% of Americans and 6.5% of Canadians employed in civilian

work were engaged in agriculture, hunting, forestry or fishing.[312] Nevertheless, this small percentage of workers was able to produce more than enough food for North Americans. Unfortunately, the same monocultural techniques that allow us to produce desirable products on a grand scale also produce undesirable by-products on an equally grand scale. Indeed, there seems to be a general consensus that without insecticides, our marvelous techniques would produce more undesirable than desirable products.[313]

The most widely publicized problematic pesticide in our period was DDT (dichloro-diphenyl-trichloro-ethane).[314] Since it has been widely used since 1942,[315] its properties are well-known. It's just barely soluble in water, requiring about one part of DDT for a trillion parts of water or, as Brinkhurst and Chant put it, "The equivalent of a single drop of dry vermouth to two whole tank cars of gin."[316] On the other hand, it's readily soluble in fats, which allows it to accummulate in living tissue such as lipids.[317] It's half-life may be 20 years or more.[318] Residues of DDT may evaporate with water and be carried far from the site where the insecticide was originally deposited.[319] Woodwell, Craig and Johnson reported that "Aerial applications of DDT to forests in the northeastern United States show that 50% or less of the amount emitted from the planes is deposited on the forest. The rest is dispersed into the air."[320] Hence, such insecticides "can turn up in antarctic seals and penguins, in deep-sea fish caught far from continental shores, and in the caribou of Canada's spacious northern wilderness. DDT can now be found in every part of the globe, in all living tissues."[321]

In one of the most frightening stories about DDT and similar pesticides, Brinkhurst and Chant claimed that a single shipload of such material "lost at sea could poison the ocean."[322] Moreover, since "North America depends on the photosynthesis of the trillions of tiny algal cells in the sea that produce seven-tenths of all the world's supply of oxygen in excess of that used in the sea itself," as the ocean goes, so goes most of the rest of us.[323] Everything, you may now recall, is connected to everything else.

Most uses of DDT were banned in Canada in 1970 and in the United States in 1973.[324] The Environmental Policy Division of the Congressional Research Service summarized the hearings preceding the American ban as follows.

"Public hearings were held on the cancellation of DDT. A total of 37 petitioners and respondents and intervenors were involved. The Environmental Protection Agency and the Environmental Defense Fund et al. defended the proposed DDT registration cancellations. The Plant Protection Division of USDA, the National Agricultural Chemicals Association, and various corporate registrants composed the opposition. The primary conclusions of law made by the hearing examiner were that DDT under its registration

is not misbranded as defined by the Federal Insecticide, Fungicide and Rodenticide Act, it is not a carcinogenic, mutagenic or teratogenic hazard to man, its registered uses do not have deleterious effects on freshwater fish, estuaries, wild birds or other wildlife, the adverse effects on beneficial animals are reasonably balanced by the benefits of DDT, there is a present and essential need for DDT's uses as defined in this case, and therefore, 'the pertinent registrations, corrected to indicate only the essential uses defined in this action, should be restored to the same force and effect each carried just prior to such notices (of cancellation).'

By far the most significant action involving pesticides was the Opinion of the Administrator concerning DDT. The Administrator's decision took issue both with the conclusions of the DDT Advisory Committee and the DDT hearing examiner. He ended general use of DDT in the United States as of December 31, 1972, as being 'an unacceptable risk to man and his environment.' Uses on three minor crops were excluded as was the use by public health officials for quarantine and for export. This action concluded 3 years of intensive review by the Government which involved 7 months of hearings.

Basic findings were that DDT is highly mobile and persistent in soils and aquatic ecosystems; its concentration in living organisms and accumulation in the food chain constitutes an 'unknown, unquantifiable risk to man and lower organisms'; DDT presents a carcinogenic risk to man and can have lethal and sublethal effects on beneficial agricultural insects, useful aquatic freshwater invertebrates, and fish, and can impair the reproductive success of births; DDT, while useful for the control of certain cotton insect pests, is becoming less effective because of increased insect resistance, and alternatives do exist."[325]

16. FORESTRY

Historically, large chunks of the inhabited regions of Canada and the United States have been carved out of forests. The same forests that farmers cleared for agriculture provided most of the available materials for fuel and buildings.[326] The forests that were not cleared provided food and shelter for wildlife, which represented additional renewable resources. Economics aside, the majesty of the great North American forests penetrates to the core of feelings that many of us have for the two countries located here.

Forestry data leave something to be desired. According to Bethel and Schreuder, "The forest survey as published by the U.S. Forest Service confounds the census and analytical functions in that it is difficult if not impossible for independent analysts to utilize and separately interpret the census information."[327] In a report described by the Director General of the Resource Industries Branch of the Department of Industry, Trade and Commerce as "the first comprehensive description and analysis of the Canadian forest products industry ever to have been published,"[328] it is admitted that there is a "lack of satisfactory data on timber quality, growth and regeneration,

losses due to fire, insects and disease and economic accessibility, as well as inconsistency and lack of comparability in the data across the country."[329]

Given the variety of views about the proper management of natural resources[330] and the difficulties of identifying forestry resources, the stage is set for conflicts. A good sample of the range of issues involved appeared in an exchange of articles in the *New York Times* in 1971. Hill claimed that

"With increasingly bitter charges and countercharges being sounded over the management of the national forests, a 6-month inquiry has shown that:
- Bulldozers and tractors are boring into some of the Nation's last remnants of pristine wilderness.
- 'Clear cutting' of timber has left thousands of square miles of bald patches in the forests, some of which may never regrow.
- Archaic laws and regulations are allowing choice expanses of the forests to be gouged and scarred by mining operations.
- Nearly half the national forests' forage areas have been overgrazed or otherwise rendered substandard.
- Preoccupation with the forests' commercial roles has severely retarded their development for public uses.
- Pressures for increased timber production have led to extensive violations of the spirit, if not the letter of laws intended to preserve the forests in perpetuity."[331]

In reply, a former chief of the U.S. Forest Service claimed that, rather than allowing wilderness areas to disappear,

"The Forest Service took the first steps to establish wilderness areas, and today, 9.9 million acres of the 10.1 million National Wilderness Preservation System are in the national forests, administered by the Forest Service.

Adding primitive areas and other specially designated areas set aside in National Forests as restricted from commercial development, the total soars to more than 15 million acres. These 23 400 square miles cover a bigger area than the combined expanses of Vermont, New Hampshire, and Massachusetts. Hardly a 'last remnant.' . . .

Your reporter also says: 'The only Federal land permanently dedicated to public use is the 28 million acres in the national parks.' His implication is that this is the only Federal acreage set aside for noncommercial public use, and that recreation is the only legitimate public use of public lands.

This, of course, is not the case. The Congress clearly stated in the Multiple Use-Sustained Yield Act of 1960 that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and fish and wildlife programs – all for the public benefit. The national forests provide more public recreation use, measured in man-days, and in greater variety than any other of the Federal lands.

The writer also stated flatly that clearcutting was adopted in 1964. Actually, clearcutting has been used for many years in the Western United States and there are literally thousands of examples where the reproduction which followed has produced excellent new forests. Clearcutting was applied in the East in the early 1960's after extensive

research showed that this method could provide satisfactory reproduction. Again through the reporter's use of quotes, he attempts to establish the point that national forest timber is being over-harvested, and that multiple use management is not being practiced.

These general implications are not true. Annual allowable cuts are established area-by-area on the basis of conditions in each national forest, not on national averages as implied in the article. These cutting ceilings are adjusted at least every 10 years to account for changes, such as tree planting, losses from fire or other causes, increased growth from improved forestry measures, withdrawals for wildernesses or other uses. In the very few instances where 'overcutting' has been done to combat insect epidemics, salvage of firekilled or windblown timber, or for other reasons, it is compensated for in subsequent planning periods.

Increases in timber harvest that occurred over the years were justified, by better utilization, improved technology, and increased growth. Land-use planning is not a precise science, but the Forest Service system of multiple use planning is as advanced as any system, applicable to large land areas, in use today. As a result, the national forests are producing more goods and services for the use and enjoyment of the American people, and in greater variety, than ever before."[332]

In spite of all the disagreement, there are some points that seem to command a consensus. For example, although the U.S. McSweeney-McNary Act of 1928 called for a "balanced wood budget," such a balance has never been achieved.[333] Moreover, there seems to be no doubt that the United States is heavily dependent on Canada for softwood lumber. Although "there is virtually free trade in pulp, newsprint and lumber in North America,"[334] Bethel and Schreuder wrote that "The United States is currently so dependent upon Canada as a source of softwood lumber and newsprint that any major restriction in price or volume could create a major materials supply problem for [the United States]."[335]

By 1974 practically all American imports of softwood lumber came from Canada, representing about 21% of American softwood consumption.[336] Eighty-three percent of the total lumber (softwood and hardwood) consumption in the United States that year was in softwood, compared to 89% for Canada.[337] The top five softwood producers in Canada accounted for 23% of all softwood production. The top 15 accounted for 41% and over a thousand smaller producers accounted for the remaining 59%.[338] These figures led the Forest Products Group of the Department of Industry, Trade and Commerce to assert that "the softwood lumber industry in Canada is still characterized by a high degree of fragmentation, particularly in comparison to other industrial sectors."[339] As we saw in earlier sections, however, such concentration ratios can be misleading. The concentration ratio of the top five softwood lumber companies in Canada in 1974 happens to be identical to the concentration ratio of the top four American energy companies in

1970[340] (T5, T45). The latter ratio, you may recall, was regarded as alarmingly high by some people, although it's lower than the ratios of the other 10 industries in Table 5. The 79% concentration in printing and writing paper production (T45) matches that of the gold mining industry (T5), which is the highest of all 11 industries listed in the latter table.

Throughout our decade the total lumber production to consumption ratios for Canada were greater than one, while for the United States they were less than one (T46, C8). Canada's 1974 ratio was 2.4, compared to 0.89 for the United States. That represented a 4% decrease over 1964 for the former and a one percent increase for the latter. Since lumber is a distinct and important natural resource, I think the total lumber production to consumption ratios are good candidates for positive social indicators. If all other things were equal, at the very least a "balanced wood budget" would be preferable to a deficit. Thus, Canada gets 11 points for its favourable stock values on this indicator. For its preferred annual flows, Canada gets 5 points and the United States gets 5.

Apart from intentional harvesting, forests are depleted by natural causes such as fires, insects and diseases. Given the vastness of the forests and the subtlety of attack of some insects and diseases, considerable guessing is involved in assessments of net depletion. Nevertheless, according to Clawson, considering all varieties of forest depletion, American forests have been at least stable and probably growing since 1920.[341] This is very likely the case in Canada too, although I could find no estimates for that whole period. In the 1964–73 period the average annual forest harvest was about half of the estimated "permissible allowable cut to maintain productive forests" indefinitely.[342] Moreover, the single, most reliably measured and dominant source of nonharvested depletion, forest fires, accounted for an annual average of 9% of the yearly losses.[343] If these statistics from the 1964–73 period are at all representative of the whole period from 1920, Canadian forests would have been at least stable and probably growing throughout the period.

While some forest fires have an ecologically constructive role to play in the preservation of healthy forests,[344] many more represent nothing but a waste of vital resources. In 1974 there were just over 8 thousand reported forest fires in Canada and 141 thousand in the United States (T47). The crucial statistics, of course, are not the numbers of fires but the sizes of the areas destroyed. Even though there were nearly 18 times as many reported fires in the United States as in Canada in 1974, there was less than two-thirds as much damage. Nearly 3 million acres of forest were destroyed in Canada that year, compared to nearly 2 million in the United States (T48,

C9). That was a substantial decrease over 1964 of 56% for the United States and only 3% for Canada. As a roughly measurable waste that one would like to avoid, the total area burned annually in forest fires may be regarded as a negative social indicator. Hence, the United States makes 4 points for its preferable stock values and Canada makes 7. For its favourable annual flows the United States makes 6 points and Canada makes 4.

17. LAND

"Buy land" Will Rogers said, "they ain't making any more of it."[345] It was probably better advice than he realized. "Land ownership has been and still is the mainstay of individual wealth, social worth, and political influence in a community."[346] While the production concentration ratios we have already examined illustrate one sort of path to wealth accumulation, the Secretary General for the United Nations Conference on Human Settlements (Habitat) claimed that "Rising land value is the greatest device for concentration of wealth in the world today."[347] "The value of land," he claimed, "even unserviced land, can be increased five, ten, or even twenty times by a change of zoning from agricultural to industrial or residential use."[348] Consequently, "In the face of such an extraordinary opportunity to create wealth without efforts, it is almost inevitable that such considerations as environment, hidden social costs, and future community need will be swept aside."[349]

Although I have never seen a national poll taken on the subject, my impression is that the vast majority of North Americans regard private land ownership as a natural right. That is, anyone should be able to own any land he or she can afford to buy, and "ownership of the land carries with it the right to do with the land as one damn well pleases."[350] Briefly, these ideas are the core of what the Special Counsel of the U.S. Senate Committee on Interior and Insular Affairs called "the frontier land ethic."[351] It had its place and time, but only an ecological ignoramus would press it today. What is required now and in the future is what the Science Council of Canada called "an attitude of stewardship, that will act as a restraining influence on human activities, and will stem not simply from felt needs but from recognition that human beings are dependent on the well-being of the things and creatures around them."[352]

It was impossible to find time series that bore directly on the question of wise land use. Table 49 gives an overview of four classes of land areas, namely, arable land (including cropped and noncropped arable land),

permanent grassland, wooded areas and a residual class including built up land, desert, tundras, muskeg, ice, dunes, mountains, and inland waters. While Canada's total land mass of about 9.9 million square kilometers is larger than the 9.3 million square kilometers of the United States, the latter has nearly 5 times as much arable land. Twenty percent or about 1.9 million square kilometers of the United States is arable land, compared to 4% or almost 400 thousand square kilometers of Canada (T49). Assuming that roughly 11% of the land surface of the whole earth is arable,[353] the United States is relatively better off and Canada is relatively worse off than the world as a whole.

In Volume I, Chapter 3.11 I reviewed some of the most important statistics on various forms of products of arable land, e.g., available food energy, nutrients, protein, fats, carbohydrates and wheat stocks. That information is certainly relevant to the question of wise land use, but there's no need to reproduce it here. Evidence of unwise land use is sporadic, often merely impressionistic and usually difficult to assess. For example, Chevalier and Burns claimed that

"The national, provincial, and local governments in Canada are virtually locked into a multitude of established patterns of regulation for taxation, planning, development, and use. Compare this frozen state of affairs in land management with rising evidence in Canada of the misuse, distorted use, and spiralling costs of land. Examples are growing speculation (further compounded by massive injections of foreign capital); large-scale manipulation of land markets; rising foreign control of land markets; growing absentee Canadian and foreign ownership of rural and recreational land; increasing concentration of corporate power in the real estate industry; steady loss of prime agricultural land to speculation and development; higher costs, and growing housing shortages; and wasteful patterns of urban development with high long-term as well as immediate price tags."[354]

In 1976 a group of scholars at Cornell University and the New York State College of Agriculture and Life Sciences published a good review of land use problems in the United States.[355] Among other things they reported that

"Each year more than 2.5 million acres of arable cropland are lost to highways, urbanization, and other special uses. This loss is partially offset by the addition (primarily by irrigation and drainage) of 1.25 million acres of newly developed cropland per year; thus, the annual net loss is 1.25 million acres of arable cropland."[356]

When the effects of natural soil erosion were added to the man-made reductions, it was estimated that in 200 years the United States had lost about 236 million acres of land suitable for crop production.[357]

It was impossible to find comparable figures for Canada. The estimates of total farmland that I found dealt with land belonging to designated farms,

which may be quite different from what the American writers were calling "arable cropland" and "land suitable for crop production." In the 1961 to 1971 period there was an estimated net decrease in total Canadian farmland of about 2.9 million acres, or about 300 thousand acres each year.[358]

18. ENVIRONMENTAL DEGRADATION

The ecologically connected triad of energy, materials and the environment has been alluded to more than once in this chapter, and the discussion so far has been concerned with the first two elements. These have been gathered together under the general rubric of 'natural resources'. This section and the next three are devoted to the third element of the triad.

In its review of environmental problems, the OECD wrote that

> "Improvements to the collection, interpretation and publication of environmental facts are essential to the further control of pollution, the successful management of natural resources and the improvement of man's quality of life. Accurate, appropriate and internationally comparable facts enable the outcome of past actions to be assessed, new initiatives to be taken and national policies to be harmonized. They permit the environmental consequences of actions to be taken into account in decision making and, when publicised, they satisfy the public "right to know". Further improvements to man's habitat are therefore dependent on the production of better environmental information."[359]

Granting the need for good data on the environment, we are still a long way from satisfying that need. In 1972 the U.S. Council on Environmental Quality wrote that "Neither this year nor next will we be able to provide a general statement about whether environmental quality has improved or deteriorated."[360] Two years later the Council noticed that one of the main stumbling blocks to progress in this area is the fact that "There are no measurable parameters called 'environmental quality', 'air quality', 'water quality', or 'ecological balance' any more than there is a measurable medical parameter called 'health'."[361] Thus, they continued, "Since we cannot directly measure environmental quality, we monitor various individual parameters – such as particulate matter concentrations in air or dissolved oxygen levels in water – which are in some way related to it."[362]

The trouble is, as usual, that there are a vast number of "individual parameters" to choose from and a vast number of techniques that might be used to do the monitoring. One source of the surfeit of possibilities of parameters is in the idea of an environment. In a very perceptive analysis, Hawley explained that

" . . . the term 'environment' has no fixed denotation. It is a generic concept for whatever is external to and potentially influential upon a unit under study. . . . Thus the act of defining refers one back to the thing environed. . . . The clarity of the environmental definition can be no greater than that of the environed unit.

A great deal of what is external to any entity is often overlooked in considerations of environment. The usual practice is to restrict the term to those externalities that are close by and directly experienced. While that may be expedient in some situations, the restriction is clearly arbitrary. . . . Environment, in other words, includes as much of what is external as can be reached in any given interval of time. Obviously, then, both location and the transportation and communication facilities possessed by a community or society are determinants of their environment."[363]

The last sentence in the preceding quotation suggests the rationale behind the selection of the three chapters of this volume. The decision to restrict environmental considerations to various forms of air, water and land degradation is mainly a matter of convenience.

For conceptualizing problems related to environmental quality, it is preferable to think in terms of degradation rather than pollution. If, for example, several species of wildlife were hunted to extinction, then their former natural habitat might be regarded as degraded or impoverished, without being polluted. Similarly, when soil is eroded by wind and water, cropland is paved over or built up, and sections of forests are clear-cut, there may be degradation that isn't caused by or directly related to pollution.[364]

For conceptualizing problems of pollution, it is useful to distinguish ambient and effluent pollution.[365] In the now familiar terms of this book, the former concerns stocks and the latter concerns flows. For example, one might measure ambient levels of water pollution by taking several samples from several sites in some body of water, and one might measure effluent levels of pollution for the same body of water by sampling several pollution sources. It's possible for ambient and effluent measures to indicate quite different states of affairs. It's also possible for different states of affairs to be indicated by the same measuring device applied to different sample areas, at the same or at different times.[366]

If all conceptual and measurement problems were solved, one might think that the elimination of environmental degradation would be as desirable as apple pie. The benefits include such things as (1) the preservation of life-sustaining eco-systems; (2) improved health for humans as well as other living things; (3) the conservation of scarce resources; (4) the efficient allocation of resources;[367] (5) new or improved recreation facilities; (6) increased use of nature's free goods and services; (7) lower costs of avoiding damages from pollution; (8) lower costs of restoring damaged goods and services;[368]

(9) the creation of whole new industries and jobs;[369] (10) the cultivation of higher levels of appreciation of one's environment, and of the roles and functions of everything in it, (11) a higher quality of life generally.

As far as I know, virtually everyone finds such things highly attractive. But the good news is not the only news. Pollution abatement is suspected of having such disadvantages as (1) increasing the costs of materials; (2) disrupting changes in the demand and supply of materials; (3) restricting the selection of mineral extraction sites; (4) diverting capital from productive to "housecleaning" uses; (5) delaying production;[370] (6) restricting industrial productivity; (7) adding tax burdens; (8) eliminating weak or marginal businesses;[371] (9) slowing industrial growth and development;[372] (10) raising levels of inflation;[373] (11) increasing the use of energy; (12) increasing the likelihood of fuel shortages;[374] (13) increasing unemployment; (14) making inefficient use of capital to pay for cleansing the last corners of an essentially benign environment.[375]

Obviously there are plenty of controversial issues involved in the preceding two paragraphs, and I can't begin to try to settle them here. All things considered, I think the benefits of pollution abatement outweigh the costs, and I suppose most people agree with me. The evidence is not overwhelming. The question was not even raised in national opinion polls in Canada. In a nationwide survey in 1970 the CIPO asked "Have you heard or read anything about the dangers of pollution – that is contamination of our air, rivers and lakes?". Ninety-one percent said "yes."[376] When the latter group was asked "How serious do you yourself think the dangers of pollution are – very serious, fairly serious, or not serious at all?", 69% replied "very serious."[377] Two years later, in response to the single question "In general how concerned are you about pollution, very concerned, fairly concerned, or not concerned at all?", only 46% replied "very concerned."[378] Westman and Conn reported on a study in Toronto that indicated "some incongruity between actual pollutant concentrations and peoples' perceptions of the problem."[379]

American pollsters were slightly more helpful. The Opinion Research Corporation raised the following question every year except 1969 in the 1965 to 1970 period. "Compared to other parts of the country, how serious, in your opinion, do you think the problem of air/water pollution is in this area – very serious, somewhat serious, or not very serious?" In June 1970, 69% thought that air pollution was "very" or "somewhat serious," while 74% felt that way about water pollution.[380] There was a steady increase of concern from 1965 to 1970.

Louis Harris and Associates asked Americans in January 1971 "What are

the two or three top problems facing people such as yourself that you would like to see the new Congress do something about?". The most frequently mentioned problem (63%) was the "state of the economy" and the "control of air and water pollution" was second (41%).[381] Eighty-three percent of respondents thought that "more money on air and water pollution control" should be spent.[382] In August of that year, 57% thought that government spending for pollution control should be "cut least" of all after aid to education.[383]

The amount and kind of government activity directed to issues may be regarded as a rough and indirect measure of popular concern with those issues. From this point of view, Americans appear to have been more concerned than Canadians with pollution. The authors of every publication I consulted in which a comparison was made between the environmental safeguards in both countries came to this same conclusion. For example, the OECD reported that more American than Canadian environmental protection laws were enacted in the period from 1963 to 1977.[384] Readers of earlier volumes of this work would have expected as much.[385]

Sykes complained that

"In New York, Nova Scotia Premier Gerald Regan offers his province as a repository for superports and refineries to service New England, slyly reminding U.S. businessmen that environmental groups fighting oil spillage and pollution 'are more heavily organized in the United States and have weapons available to them such as injunctions that aren't available under the Canadian constitution.' "[386]

In a report in *Science*, Carter claimed that while

"Plans to sell leases for potential oil-and gas-bearing tracts on the U.S. outercontinental shelf (OCS) continue to generate outcries from state and local officials and environmental leaders worried about possible adverse impacts. . . . the Canadian government has been moving quietly toward a final decision to allow exploratory oil drilling to begin in that part of the Arctic Ocean known as the Beaufort Sea, an OCS province so fraught with environmental problems and hazards that the technology necessary for recovery of the oil and gas that might be found is still far from being available."[387]

The general theme of the relative ease of access to northern resources free of environmental safeguards granted by Canadian officials is repeated in Dosman's *The National Interest: The Politics of Northern Development 1968–1975*.[388] In his view, too much of the crucial decision-making concerning northern development simply by-passes Parliament. The remedy?

"To the extent that the discretion of senior officials and regulatory boards is replaced

by precise legislation, such as the National Environmental [Policy] Act (1970) in the United States, Parliament will regain some control over events in the North."[389]

In fact the Bill (c-207) creating the Department of the Environment or, briefly, Environment Canada, was introduced in the House of Commons in December of 1970, and the department formally came into being in June 1971.[390] The scope of the agency's authority is broad, covering such things as resource management, pollution control, assessment of the likely impact of new industrial development, long range planning, international co-operation and information distribution.[391] Nevertheless, three years after the department opened its doors, Estrin wrote that

"New government agencies such as Environment Ontario, Environment Canada, and the Clean Environment Commission of Manitoba . . . were part of the advent of intensive public relations as a technique of government. Such measures bring reassurance to many; indeed, it is all too easy today to delude oneself that merely because a government department is assigned a particular task, the responsibility will be discharged. Unfortunately, the responsibility is all too rarely discharged, although the public continues to be reassured that everything is under control.

When Ontario's Environmental Protection Act was being rushed through the legislature in 1971, it was described by the Premier as an 'Environmental Bill of Rights.' Similar purportedly comprehensive legislation in other provinces was no doubt also described in glowing terms by the sponsoring politicians.

More than anything else the Ontario Environmental Protection Act, just like almost every other piece of environmental legislation introduced anywhere in Canada in the early 1970's, methodically denies every possible public or private right to ensure that Canadian citizens obtain a healthy and attractive environment.

It is the purest fantasy to herald the Ontario legislation or any other present environmental law presently in force in Canada as a Bill of Rights. . . .

If misleading advertising laws applied to politics, no doubt many of our federal and provincial politicians would have been severely fined or even jailed by now for the way in which they have misrepresented their all-encompassing 'environmental bills of rights'."[392]

At the risk of making a sad story even sadder, Canadians who regard NEPA-type legislation as the light at the end of the tunnel should be aware of its deficiencies. For example, in a carefully documented analysis Fairfax claimed that

" . . . far from being a salubrious process in need of further elaboration and refinement, NEPA has been a disaster for the environmental movement and for the quest for environmental quality. . . .

Supporters of NEPA herald it as major legislation which reformed administrative decision-making by requiring consideration of alternatives and environmental variables

and by involving the public and the courts in decision-making. However, NEPA did not cause any of these reforms and to the extent that the reforms themselves are productive, NEPA actually detracted from their development.

The tragedy of NEPA is that it turned energy, attention, and effort away from a redefinition of agency authorities and spent it on proliferating paper."[393]

19. AIR POLLUTION

Ordinary unpolluted air is a mixture of gases, including about 78% nitrogen and 20% oxygen, with the remaining 2% made up of carbon dioxide, argon, some rare gases and water vapor.[394] Air pollution occurs when some natural airshed is permeated with enough foreign masses or gases to present a health hazard to anything living in the area.[395] The term 'masses' is used broadly here to cover a variety of minerals (e.g., asbestos, lead, beryllium, cadmium) that are often found with the dust, soot and grit technically known as 'suspended particulate matter.'[396] The gases include primarily (1) compounds of sulfur and oxygen, collectively known as 'sulfur oxides' (SO_x), with sulfur dioxide (SO_2) as a prominant species; (2) compounds of nitrogen and oxygen, collectively known as 'nitrogen oxides' (NO_x), with nitrogen dioxide (NO_2) as an important species; (3) compounds of carbon and oxygen, carbon monoxide (CO) and carbon dioxide (CO_2); and (4) compounds of carbon and hydrogen, the hydrocarbons (HC).[397]

In the natural course of events, the weather and winds function as the air's cleaning system.[398] However,

"If there is little air movement, whatever is introduced into the air by local activities – for example, smog – tends to accumulate in the air. Still-air conditions have a way of perpetuating themselves. When air is still, it tends to develop into an upper zone of warm air and a lower zone of cold air. This reverses the usual situation, in which the lower layers of air are warmer than the upper ones; it is therefore called an *inversion*. Since cold air is denser than warm air, vertical circulation is prevented under inversion conditions. An inversion may hold the air mass over a city in place for some days. When that happens, as it did in New York City in November 1966, pollutants may accumulate to the point of an emergency."[399]

There have been several fairly notorious emergencies presumably precipitated to some extent by inversions. For example, Commoner mentioned a five-day smog attack in London, England in 1952, which resulted in 4000 deaths.[400] The eight-day inversion of 1948 in Donora, Pennsylvania is supposed to have increased the death rate there by 400%.[401] An inversion in New York City in 1966 is alleged to have accounted for as many as 175 lives.[402]

While such spectacular events dramatize the dangers of air pollution, they don't represent the most serious hazards. The latter are represented by guesstimated marginal increments in various rates of morbidity and mortality. The general contours of statistics on death and disease involving malignant neoplasms (cancers), the circulatory and respiratory systems were examined in Volume I, Chapter 3.4 to 3.6. Before proceeding to a review of the indicators for the primary air pollutants mentioned above, a few remarks on some insidious long-term effects of such pollutants will be instructive.

In a nice literature review, published ten years ago, Lave and Seskin cited studies from England, the United States, Japan and Australia that estimated "a doubling of the bronchitis mortality rate for urban, as compared to rural, areas" as a result of air pollution.[403] Other studies in which areas of high pollution were compared to areas of low pollution showed that the former were related to "significant mortality-rate increases associated with individual categories of cancer, such as stomach cancer, cancer of the esophagus, and cancer of the bladder."[404] The morbidity rate for heart disease in Nashville, Tennessee was found to be "about twice as high in areas of polluted air as in areas of clean air."[405]

After carefully examining the literature, Lave and Seskin concluded thus:

"In preceding sections we have described a number of studies which quantify the relationship between air pollution and both morbidity and mortality. Is the evidence conclusive? Is it possible for a reasonable man still to object that there is no evidence of a substantial quantitative association. We believe that there is conclusive evidence of such an association."[406]

The only air pollution indicators available that begin to approach comparability (probably at some distance) are summarized in Table 50. I will briefly consider each pollutant separately and try to assess its role in our story.

In 1974, about 27.5 thousand tons of sulfur oxides were emitted into the air for every 100 000 Canadians, compared to about 14.7 thousand tons for every 100 000 Americans (T50). The following year Canada's total emission levels for sulfur dioxide per unit of energy consumed were the highest of all OECD countries.[407] For both countries about a quarter of sulfur oxides emissions come from stationary fuel combustion plants; in a word, furnaces.[408] What's being burned in the furnaces producing the pollutants is fossil fuel, especially coal.

Generally speaking there are three ways to reduce sulfur oxides emissions while burning coal, namely, (1) use coal with a naturally low sulfur content;

(2) clean the coal prior to combustion; or (3) use stack gas scrubbers to prevent the pollutant from being emitted after combustion.[409] The second alternative has been a relative non-starter. Virtually all of the low-sulfur coal deposits in the United States are west of the Mississippi River,[410] which is where most of any kind of Canadian coal is located.[411] Since most of the industry in North America is east of the Mississippi and it costs money to move coal across the continent, scrubbers have been the preferred alternative. By 1940 there were over 200 "United States and foreign patents relating to sulphur dioxide removal and recovery from waste gases."[412] Thirty-eight years later Gordon claimed that "Most of the successful units are engaged in mild scrubbing (50 to 60% removal) of sulfur oxides from low sulfur coal."[413] Nevertheless, he insisted, " . . . scrubbers create cost, reliability, and waste disposal problems that could exceed those associated with nuclear power."[414] All that raised the following reflections.

> "How then did the devotion to scrubbers arise, why the problems, and why the move to increased reliance despite such difficulties? The initial impetus is easy to explain. The policy-makers eagerly accepted the arguments of the equipment manufacturers and the coal industry that scrubbers were a cheap, available solution. Thus, scrubbers seemed an ideal solution – providing speed, low costs, and maintenance of existing regional production patterns. The question of why problems arose is simpler to explain; scrubber advocates failed to anticipate the difficulties."[415]

Even if one grants that scrubbers represent a very bad solution to the sulfur oxides problems, one would be hard pressed to find a very good solution. If coal is going to be burned, then scrubbers still seem preferable to the other two options. At best one can only press for greater conservation, less waste and, therefore, a reduced need to burn coal.

In 1974 about 9.3 thousand tons of nitrogen oxides were emitted into the air for every 100 000 Canadians, and about 11.8 thousand tons for every 100 000 Americans (T50). Together with sulfur dioxide, nitrogen oxides in the air are responsible for acid rain.[416] When these compounds come in contact with water particles in clouds and raindrops, sulfur dioxide forms sulfurous and sulfuric acids and nitrogen dioxide forms nitrous and nitric acids.[417] Precipitation containing such acids has become practically a global problem,[418] with the pollutants being tracked over a thousand kilometers from their sources.[419] The rain destroys the life-sustaining properties of lakes and soil,[420] causes half the "man-made corrosion of cars," and eats into the surfaces of "marble, limestone and granite buildings and statues . . . ."[421] According to a report of the Waterloo, Ontario Public Interest Research

Group, the Ontario Ministry of the Environment has reported that "140 acified lakes in Ontario are now devoid of fish"[422] and

> "A further 48 500 lakes within the province 'will not be able to tolerate, for any extended period of time, continued acid inputs . . . . At current rates of deposition all these lakes could be dead (no longer able to support a fishery) within the next twenty years.'"[423]

In the same report it was pointed out that "Over 100 lakes in the Adirondack Mountains of New York State are devoid of fish life as a result of high acid levels."[424]

About 68.3 thousand tons of carbon monoxide were emitted into the air for every 100 000 Canadians in 1974, and about 47.6 thousand tons for every 100 000 Americans (T50). At least 70% of such emissions typically came from gasoline-powered vehicles (about which I will have much more to say in the next chapter).[425] Carbon monoxide is a colourless, odorless, tasteless, poisonous gas produced from incomplete combustion of carbon-containing fuels.[426] It "has the effect of reducing oxygen available to the brain and body cells and is responsible for increased stress on the heart and lungs."[427] According to Bohn, "the only known mechanism by which this serious pollutant is removed from the earth's atmosphere" is through soil absorption followed by a transformation brought about by the activity of microorganisms.[428] This is a perfect example of what Westman and Conn call a "free service of nature," a service that is lost forever when agricultural land is paved over or built up.

A bit over 11 thousand tons of hydrocarbons were emitted into the air for every 100 000 Canadians in 1974, and nearly 15 thousand tons for every 100 000 Americans (T50). When hydrocarbons and nitrogen oxides interact, the result is ozone, "the predominant chemical constituent in the family of compounds called photochemical oxidants."[429] Ozone is a natural constituent of the stratosphere and a protective shield keeping solar ultraviolet radiation off our backs. Without ozone there could be no terrestrial life as we know it.[430] Moreover, there is considerable concern that the use of chlorofluorocarbons in air conditioning and refrigeration systems, insulating materials, cleaning and medical equipment, and most aerosol spray cans will significantly deplete the stratospheric ozone.[431] Unfortunately, too much ozone would also be disastrous. If all ultraviolet radiation were blocked, the result would be "an increase in rain, hail, and snow, and a significant lowering of the earth's temperature," i.e., the so-called Icebox Effect.[432] In contrast to the Icebox Effect, it's possible that we will succumb to a Greenhouse

Effect.[433] The latter could come about as a result of putting so much carbon dioxide into the air that ultraviolet radiation is unable to escape. In the worst of all worlds, the earth's temperature would rise, polar ice caps would melt, ocean levels would rise a few hundred feet and places like New York City, Boston and Halifax would disappear under the sea.[434] If I had to bet, I think I would put my money on the Greenhouse Effect; but I'm glad I don't have to bet.

The last air pollutants to be noticed are the total suspended particulates. Common usage seems to allow the shorter phrase 'fly ash' to be used in place of 'total suspended particulates,'[435] although *Webster's New Collegiate Dictionary* restricts the former to "fine solid particles of noncombustible ash carried out of a bed of solid fuel by the draft." In 1974 10.6 thousand tons of particulates were emitted into the air for every 100 000 Canadians, and 9.1 thousand for every 100 000 Americans (T50). Most particulate emissions are from industrial processes and coal-powered electric generating plants,[436] and some of the dangers of the latter were mentioned above in Section 11. According to Esposito, "In Los Angeles alone, jet aircraft produce daily as much particulate matter as one million automobiles."[437]

Besides 1974, 1972 and 1970 are the only other years for which air pollution indicators are available to be compared (T50). Using the emission rates per 100 000 inhabitants for each of the five types of pollutants as negative social indicators, Canada makes 8 points for its preferable stock values and the United States makes 7. For its superior biennial flows, Canada makes 4 points and the United States makes 6.

20. WATER

Article IV of the 1909 Treaty with Great Britain Relating to Boundary Waters Between the United States and Canada says that "It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."[438] To prevent or settle any disputes involving the boundary waters, a six person International Joint Commission was appointed.[439] In 1912 the two governments asked the Commission to prepare a report on the status of the boundary waters with, among other things, respect to the commitments contained in Article IV. "In 1918," Ross wrote, "the Commission reported back to the Governments that its comprehensive survey disclosed 'a situation along the frontier which is generally chaotic, everywhere perilous, and in some cases disgraceful.'"[440] I wonder how

those Commissioners would have felt if they had heard about the "67 000 tons of asbestos laden tailings" dumped daily into Lake Superior.[441]

The outstanding boundary waters between Canada and the United States are of course the Great Lakes. The significance of the area surrounding these waters reveals the significance of the waters themselves.

"The Great Lakes-St Lawrence basin contains one of the world's largest and most rapidly growing urban-industrial complexes. The United States portion contains one seventh of its national population, produces one sixth of its national income and is the location of four of the twelve large U.S. cities-Chicago, Detroit, Cleveland and Milwaukee. The Canadian statistics are more spectacular. The Canadian portion of the basin constitutes about 13% of the total area of Canada; however, only one-thirteenth of the basin, or 1% of Canada's total area, comprising peninsular Ontario and the St. Lawrence Lowlands in Quebec, contains more than three quarters of the country's industrial activity, almost two thirds of the population, and about half the dollar value of Canadian agricultural production. ... The region encompassing Lakes Erie and Ontario is the focus of the primary iron and steel industry of North America accounting for approximately 40% of the U.S. production and about 80% of the Canadian production."[442]

Table 51 contains a summary of four types of pollutants found in fish in the Great Lakes, namely, the already familiar DDT and mercury, plus dieldrin and polychlorinated biphenyls (PCBs). The latter chemicals are highly toxic chlorinated hydrocarbons. Dieldrin is used in insecticides and PCBs are used for electrical insulation, adhesives, ink solvents and textile coatings.[443] In the 1969 to 1976 period, definite progress was made in reducing the amount of DDT in lake trout, coho salmon and bloaters.[444] By the final year the maximum allowable level of 5 parts per million (ppm) was achieved for salmon and apparently for bloaters, and nearly achieved for trout. The maximum allowable level of 0.3 ppm for dieldrin was achieved for trout and salmon, but not for bloaters. For PCBs the maximum allowable level of 5 ppm was achieved for bloaters, but not for the other two species. The PCB level of 18.68 ppm found in lake trout was the highest level of pollutant found in any of the sampled species. The maximum allowable mercury level of 0.5 ppm was achieved in three of four species tested.

Of the five lakes, Lake Erie has probably received the most publicity. "It is the shallowest lake with over 90% of its total area less than 80 feet deep."[445] According to Regier and Hartman, "The commercial catch of fish from Lake Erie over the past 150 years has exceeded that of the other four Great Lakes combined."[446] Commoner devoted a whole chapter of his influential *The Closing Circle* to this lake. "In the last decade," he wrote, "the people living near Lake Erie have had ample evidence of its deterioration.

Nearly all the beaches they once enjoyed have been closed by pollution; each summer huge mounds of decaying fish and algae pile up on the shore; the once sparkling water is dense with muck; oil discharged into one of its tributary rivers has burst into flame. Lake Erie's living balance has been upset and if the lake is not yet 'dead', it certainly appears to be in the grip of a fatal disease."[447] That was in 1971. Two years later Regier and Hartman claimed that "No attempt has been effective enough to halt the progressive degradation of water quality."[448] Ross, on the other hand, seemed to believe that in time the 1972 "Agreement between Canada and the United States of America on Great Lakes Water Quality" would prove to be an effective device for arresting the deterioration of all the lakes.[449] I hope so.

For several reasons there are no comparable water quality indicators for Canada and the United States. Because watersheds or basins are relatively self-contained, what happens in one may have little or nothing to do with what happens in another. So monitoring the quality of water in one typically provides no information about the quality of water in another. The Council on Environmental Quality reported that

"Water quality monitoring in the United States reached a milestone in 1975. For the first time, uniform monitoring stations representing all of the nation's 334 subregional water quality accounting units were in operation. With the development of the U.S. Geological Survey's National Stream Quality Accounting Network (NASQAN), we now have a uniform capability to observe gross geographic patterns of water quality for the entire United States."[450]

In sharp contrast, as late as 1975 Canadians didn't even know how many lakes they had.[451] However, they did know that they had 563 "large lakes with water surface areas of at least 100 square kilometres (38.6 square miles)."[452] What percentage of these lakes might be polluted to what degree with what pollutants is anybody's guess.

Besides water pollution, there is a question of the degradation of North American waterways by irresponsible engineering. In a very provocative study of Canadian water resources, Bocking wrote that

"Because water development is an irreversible process, it surely is essential to try to determine what relationship exists between the water resources of our country, and the nature and identity of Canada and Canadians. We must discover before they have restructured the face of the nation if there is reason to consider the water resources of Canada in terms different from those of water developers and engineers. In the new context of the nineteen-seventies, we must ask if there's a valid reason for trying to re-capture the vision of the men of the North West Company; the concept of a land unified by its free-flowing waters."[453]

In light of perennial Canadian identity problems cited in earlier volumes,[454] a cynic might scoff at such passages as just more suds in a senile soap opera. (Might as well look for Canadian identity at the bottom of our lakes as anywhere else.) I think that would be a serious mistake. It's hardly an inconsequential accident that "Practically every city in Canada has grown up along the banks of a river or lake."[455] After all, "Access to transportation, recreation, convenient water supply, relatively level land for building, fertile land for crops, a pleasant view – all these advantages are to be found on waterfront land and, as a result, the most desirable land is usually the land closest to the water."[456] So it doesn't seem farfetched to suggest that changing the shape of our waterways will inevitably change the shape of our settlements, our futures and our visions of our homeland. If all that is changed, it's difficult to see how we ourselves could fail to be changed. Indeed, that too seems inevitable.

Change is one thing, degradation is something else. It might be objected that to think of significantly altered waterways as degraded is to beg the question of whether such alterations ever represent improvements. There are plenty of examples of waterways that were altered in one way or another to prevent floods, drain swamps, irrigate dry areas and provide hydroelectric power, with all the benefits such changes can bring. Furthermore, there's no reason to suppose that there will never be another worthwhile waterway alteration.

I think this objection has merit, and that's why I introduced the topic as the "question" of waterway degradation. Without trying to determine the net benefits and costs of all previous water projects, I would like to offer a few remarks about some of them from the point of view of their impact on the quality of life in North America.

Given all the problems connected to the generation of electricity from nuclear fission and fossil fuels, the use of water power looks extremely attractive. The process of converting the kinetic energy in falling water to electricity is about 90% efficient.[457] Hydroelectric plants are relatively inexpensive to build and to operate, and they don't produce the hazardous pollutants associated with their thermal alternatives.[458] Nevertheless, there are fairly predictable costs involved in the development of such plants. For example, dams usually have to be built to raise water levels above turbines. Water levels can only be raised by flooding relatively dry areas, which may include arable land, wildlife habitats, recreational and scenic areas. Increases in water surface areas will lead to increases in evaporation losses of fresh water.[459] Increases in water depth will tend to lower water temperatures,

and reduce circulation and oxygen levels, which may create a hostile environment for acquatic life.[460] The movement of anadromous fish to spawning areas may be curtailed, again contributing to the reduction or elimination of fisheries.[461] Since (1) "The percentage of edible lean tissue in fish is appreciably greater than that in beef, pork, or poultry." (2) "The caloric value of dressed fish is about one third that of the edible portion of beef or pork." and (3) "Fish can convert food into body tissue more efficiently than farm animals.",[462] there will surely be more fish in our future. So the destruction of natural fisheries is bound to lead to the development of manmade fisheries with additional unnecessary costs. Meanwhile there will be increased social and economic disruption as people traditionally dependent on natural fisheries and other wildlife are driven from their land.[463] As if all of this weren't enough, Bocking contends that

" . . . while the resource [waterway] in its natural state will exist and be of value to man forever, water developments not only tend toward obsolescence but in a period of time – perhaps less than a century, perhaps a couple of centuries – the reservoir will have silted in and will be useless. Dams are temporary in usefulness; the destruction they cause is permanent."[464]

A similar tale can be told regarding irrigation projects. For example, the Canadian Northwest Irrigation Act of 1894 was designed to attract settlers to Alberta and the southern parts of the Northwest Territories, and to "prevent the uncontrolled migration of American settlers into the Canadian West."[465] It seems to have had precisely those effects, besides increasing the value of the land that was irrigated. Unfortunately, it soon "became apparent that prospects for profitable investment in irrigation projects were largely illusory," and private investment was not going to be available.[466] Hence, taxpayers were obliged to bear an increasingly large share of the burden of uneconomical farming.

South of the border it has been estimated that

"Between 5 and 17 million acres of farm land in other areas of the United States were forced out of production by new irrigated land between 1944 and 1964. Subsidized irrigation in the west made cheaper production of some crops possible, pushing out of production land that normally grew those crops in other regions, principally the southern U.S."[467]

The result, of course, was increased unemployment and social disruption, with bankrupt southern farmers and their families frequently migrating to cities in search of relief. The sting of such dislocation still smarts. When, for example, a plan was revealed to move water from the Mississippi River across

Louisiana to irrigate "cotton fields of the high plains of west Texas," "Senator Russell Long of Louisiana . . . said: 'Texas will get our water over my dead body.' "[468]

In the presence of such strong feelings about keeping American water wherever it happens to be, Bocking argued that the pressure to move Canadian water south is bound to increase. The arguments are worth quoting.

"First, the desert and semi-arid lands of the Southwest are of almost no value for any purpose without water. Second, the adding of water to dry land can overnight increase its value from almost nothing to $1000 or more per acre. Third, agriculture in these dry regions is carried on by a small number of large farm corporations, and the family farm is almost non-existent. Fourth, the land is largely owned by very big corporations-oil companies, land holding companies, banks. The prospect of receiving subsidized water to grow crops at guaranteed subsidized prices on land that water has caused to appreciate enormously in value is, to say the least, attractive. The large land holding companies, oil companies, banks and conglomerates that own the land wield the sort of power that can make such dreams come true. There are additional members of the 'water establishment'. There are the contractors who would build the enormous structures required for water movement, concrete and other materials companies, construction equipment firms, water development and distribution agencies and their supporting lobbies. Clearly, the most powerful elements of the political, social and economic structures stand to gain most from water importation. The pressures on politicians that all of these groups can generate are enormous. As the authoritative text *Water Supply* puts it: 'When the benefits go to a well-defined interest group for whom it is worthwhile making the political investments necessary to assure passage of the legislature, while the costs are dispersed so widely as not to justify anyone's organizing political opposition, special interest groups are all too likely to win out against the general public.' "[469]

According to Bocking,[470] Ridgeway,[471] McDougall[472] and Sykes,[473] the Columbia River Treaty of 1964 represents a clear case in which the elements mentioned in the preceding quotation came together to produce a sell-out of a major Canadian water resource. Sykes summarized the exchange thus:

"As a result of the Columbia River treaty Canada gained: an American market for British Columbia for $274.8 million in downstream power benefits; financing for three storage dams on the Columbia River; $68.3 million for flood control benefits; $112 million in interest and other payments; some power benefit from the flooding of Mica Creek. It comes to a rough total of $455 million.

Canada lost: control of the flows of the Columbia and Kootenay rivers; millions in power potential; billions in consumptive values; land flooded at High Arrow and Libby dams, which provided no power, flood control or consumptive benefits to Canada; cost of compensation to landowners; cost of providing permanent flood control for the state of Washington; cost of clearing Canadian land to be flooded for a dam located in Montana and serving only the United States. These items add up to a total that has never been and perhaps never can be computed."[474]

21. WILDLIFE

The last indicators of environmental degradation to be considered are based on reductions in the sizes of the populations of various species of wildlife. I began my search for such indicators with an assumption identical to Inhaber's, namely, "The greater the number of endangered species, the more we have reduced the quality of our environment."[475] Even if it is granted that there may well be some species that the world would be better off without, I think the burden of proving that any particular species belongs to such a class of undesirables is up to anyone making the charge regarding that species.

Concerning indigenous species of fauna or flora, there is an agreement in OECD countries that an *endangered species* is "one that is in danger of extinction throughout all or a significant part of its natural habitat" and "A *threatened species* is one that is likely to become endangered in the foreseeable future."[476] The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), representing federal, provincial and private agencies concerned with wildlife, recognizes three other kinds of reduced population sizes. A *rare species* is one that "exists in low numbers or in very restricted areas in Canada but is not a threatened species."[477] An *extirpated species* is one "no longer existing in the wild in Canada but existing elsewhere," and an *extinct species* is one "no longer existing anywhere."[478]

The statistics available on endangered or threatened species are limited, just barely comparable and outside the 1964–74 period. Still, they provide a rough picture of an important aspect of environmental quality.

In 1978 COSEWIC identified 8 endangered and 3 threatened species (T52), which is far short of the 197 endangered and 39 threatened species identified by the Fish and Wildlife Service of the U.S. Department of the Interior (T53). Some of the same species are in trouble in both countries, e.g., the whooping crane and the black footed ferret (T52, T54). Subspecies of falcon, prairie dog and prairie chicken are also suffering reduced populations.

The Office of Migratory Bird Management of the U.S. Department of the Interior produced an inventory of waterfowl for the whole continent (T55). While the estimates are admittedly rough, they at least suggest that there are some flourishing species enjoying habitats spanning both Canada and the United States.

Finally, I must comment on one of the most distressing sets of statistics in this whole book. Table 56 lists the number of wildlife and farm fur-bearing animals destroyed in 1974–75 for their pelts. Fur trade represents, as a

recent report of the Science Council of Canada put it, "the earliest instance of development based on resources."[479]

"The fur trade helped to establish a political presence, open up to the Europeans unexplored areas of the country, and indicated that the wealth acquired by trapping animals and shipping pelts out of the country in large quantities could initiate development."[480]

Forty-one million dollars worth of furs is hardly to be sneezed at, and I have no doubt that plenty of worthwhile things have come out of fur trade. But I don't believe that enough good could have come out of the slaughter of over four million animals to justify the exchange. I'm even more convinced that an annual exchange of this sort cannot be justified. I know that trapping and trading in furs is a way of life with ancient roots. Nevertheless, it's a way of life that is more to be pitied than admired, or even ignored. In the best of all possible worlds, no one would have or want to be clothed in the skin of another creature. Or, putting my view positively, in a better world, people would value the skin of other creatures as they value their own, and they would no more think of peeling off the skin of the former than the latter.

22. CONSERVATION

Part of the message of this chapter was summarized beautifully by Boulding, i.e., "An erg saved is an erg earned . . . ."[481] The fact is that anything saved may be regarded as something earned, e.g., money, energy, land, wildlife, and so on. Thus, it should come as no surprise that with all the interest in the supply and demand of resources, some people began to take a very careful look at demand.

In Section 4 I mentioned that there were nations with living standards similar to those of North Americans but requiring half the energy consumption. In 1973 *Newsweek* carried an article claiming that "All in all, the U.S. wastes fully 50% of all the energy it burns."[482] Seven years later the U.S. National Academy of Sciences Committee on Nuclear and Alternative Energy Systems (CONAES) issued a report asserting that "over the next 30 to 40 years technical efficiency measures alone could reduce by half the present ratio of energy consumption to Gross National Product."[483]

In 1977 the Science Council of Canada issued a report called *Canada as a Conserver Society* in which the following explanation of the idea was presented.

"A Conserver Society is on principle against waste and pollution. Therefore it is a society which

. promotes economy of design of all systems, i.e., 'doing more with less';
. favours re-use or recycling and, wherever possible, reduction at source;
. questions the ever-growing per capita demand for consumer goods, artificially encouraged by modern marketing techniques, and
. recognizes that a diversity of solutions in many systems, such as energy and transportation, might in effect increase their overall economy, stability, and resiliency.

In a Conserver Society, the pricing mechanism should reflect, not just the private cost, but as much as possible the total cost to society, including energy and materials used, ecological impact and social considerations. This will permit the market system to allocate resources in a manner that more closely reflects societal needs, both immediate and long term."[484]

Later in the report the following important clarification was offered.

" . . . the Conserver Society implies more than conservation. Conservation becomes a function or output which arises both from an understanding of our system and its various subsystems and when that understanding leads to innovation. In other words, *conservation occurs as the result of a much more appropriate and sensitive re-ordering and redesigning of activities. This is the creative core of the Conserver Society concept, and it is closely linked to the need for diversity and flexibility.*"[485] (Emphasis added.)

In an interview given to *Science* in 1980, the chairman of the President's Council on Environmental Quality asserted practically the very same principles. But he also expressed grave doubts about the possibility of bringing about such a society in the United States without checking the "influence of corporations" by "reform of political campaign financing."[486] Several problems with campaign financing in North American elections were discussed in Volume II, Chapter 5.5, and the evils of unbridled corporate avarice have been cited repeatedly. Again, however, I would like to caution readers against the facile transference of personal blame to impersonal forces and systems. The moral buck must finally stop at each person's own doorstep. In particular, every North American must assume personal responsibility for his or her own "sensitive re-ordering and redesigning of activities" in order to arrest and reverse the waste and degradation of the earth's natural resources.

23. SUMMARY AND RESULTS

We have covered an enormous amount of ground to uncover only seven usable social indicators related to natural resources and the environment. The results of my comparative assessment based on these seven indicators are summarized in the following matrix.

SOCIAL INDICATOR	CANADA STOCK	CANADA FLOW	USA STOCK	USA FLOW
1. Energy consumption per capita	11	2	0	8
2. Energy production/consumption	10	7	1	3
3. Selected metals production/ consumption	11	3	0	5
4. Total chemicals export/import	0	5	9	3
5. Lumber production/ consumption	11	5	0	5
6. Forest area burned	7	4	4	6
7. Air pollution	8	4	7	6
Resources subtotal	58	30	21	36
Resources Total	88		57	
Recreation	84		74	
Education	64		61	
Science/Technology	39		49	
Politics	67		36	
Criminal Justice	55		57	
Health	147		113	
Population	51		23	
Combined Total	595		470	

With respect to the general area of natural resources and the environment, the quality of life in Canada is higher than that in the United States. The final area score was 88 to 57. If the results of previous chapters are added to those of this chapter, the quality of life in Canada still looks higher than that in the United States. The combined score is 595 to 470.

If one looks at the first and last recorded stock values for the usable indicators for each country independently of the other country, one may get a sense of the direction in which the two countries have been moving. The results of this examination are summarized below.

In the area of natural resources and the environment, the United States improved in more ways than it deteriorated while Canada deteriorated in more ways than it improved. When these results are combined with those

SOCIAL INDICATOR	CANADA		USA	
	BETTER	WORSE	BETTER	WORSE
1. Energy consumption per capita	0	1	0	1
2. Energy production/ consumption	1	0	0	1
3. Selected metals production/ consumption	0	1	0	0
4. Total chemicals export/ import	0	1	1	0
5. Lumber production/ consumption	0	1	1	0
6. Forest area burned	1	0	1	0
7. Air pollution	1	0	1	0
Resources Total	3	4	4	2
Recreation	6	2	5	3
Education	5	2	4	1
Science/Technology	3	3	3	3
Politics	5	3	4	5
Criminal Justice	2	2	2	2
Health	8	6	7	7
Population	3	2	1	4
Combined Total	35	24	30	27

of previous chapters, one finds that both countries have become better in more ways than they have become worse. However, Canada has become better in more ways and worse in fewer ways than the United States.

Putting all evaluations aside, the countries have tended to be or become similar with respect to the following.

1. Energy consumption per capita
2. Percent of electricity production, thermal
3. Percent of electricity production, hydro
4. Government funding for civilian nuclear R & D as a percent of total government R & D expenditure

5. Per capita government funding for civilian nuclear R & D
6. Natural gas production/consumption
7. Coal production/consumption
8. Selected metals production/consumption
9. Iron ore production/consumption
10. Aluminum production/consumption
11. Nickel production/consumption
12. Magnesium production/consumption
13. Total chemicals export/import
14. Insecticides export/import
15. Organic chemicals export/import
16. Soaps export/import
17. Paints export/import
18. Plastics export/import
19. Lumber production/consumption
20. Forest area burned
21. Sulfur oxides emissions
22. Nitrogen oxides emissions

The countries have tended to be or become dissimilar with respect to the following:

1. Energy production/consumption
2. Electricity consumption
3. Percent of electricity production, nuclear
4. Uranium oxide production
5. Crude petroleum production/consumption
6. Copper production/consumption
7. Mercury production/consumption
8. Zinc production/consumption
9. Fertilizers export/import
10. Inorganic chemicals export/import
11. Medicines export/import
12. Perfumes export/import
13. Explosives export/import
14. Carbon monoxide emissions
15. Suspended particulate emissions
16. Hydrocarbon emissions

In the area of natural resources and the environment then, the two countries tended to be or become similar in more ways than they tended to be or

become dissimilar. If these results are added to those of Chapters Two to Eight, then there are a total of 86 nonindependent paths that have tended to converge and 94 that have tended to diverge. These are summarized below.

	NUMBERS OF NONINDEPENDENT PATHS TENDING TO	
AREA	CONVERGE	DIVERGE
Population	21	11
Health	17	18
Criminal Justice	4	22
Politics	3	5
Science/Technology	7	5
Education	7	11
Recreation	5	6
Environment/Resources	22	16
Total	86	94

Since there were no national polls in which the same question was asked in the same year, we still have 27 items for which essentially similar responses were given in both countries and 33 items for which essentially different responses were given. The results of all chapters are summarized below.

	SURVEY QUESTIONS FOR WHICH ANSWERS WERE ESSENTIALLY	
AREA	THE SAME	DIFFERENT
Population	10	3
Health	3	2
Criminal Justice	1	9
Politics	10	16
Science/Technology	0	0
Education	1	2
Recreation	2	1
Environment/Resources	0	0
Total	27	33

Very briefly then, the combined evidence of this chapter and the last seven yields the following three conclusions. In the 1964–74 period,

(a) The comparative quality of life was higher in Canada than in the United States.

(b) More often than not the movement beyond the 1964 baseline for both countries was for the better.

(c) Canada and the United States tended to be or become dissimilar in more ways than they tended to be or become similar.

NOTES

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[21] *Ibid.*
[22] *Ibid.*
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[25] *Ibid.*, pp. 8–9.
[26] *Ibid.*, p. 9.
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[33] *Ibid.*, p. 109.
[34] *Ibid.*, pp. 110–111.
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[59] *Ibid.*
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[65] Sporn, *op. cit.*, p. 284.
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[100] *Ibid.*, pp. 34–36, 58–61, 73–74, and 92–95.
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[102] Federal Trade Commission, *op. cit.*, p. 20.
[103] The problem is addressed in Volume I, Chapter 1.5.
[104] Federal Trade Commission, *op. cit.*, p. 19.
[105] A British thermal unit (B.t.u.) is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.
[106] With one exception: the 20-firm production concentration ratio for uranium milling was 100 percent throughout the period.
[107] The natural gas production figures include Canadian production, and the uranium figures are for the milling rather than the mining stage.
[108] Federal Trade Commission, *op. cit.*, pp. 145, 149–150.
[109] United Nations, *op. cit.*, p. 43, Table 2.
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[111] A gigawatt equals a billion watts.

[112] U.S. Department of Energy, and Department of Energy, Mines and Resources Canada, *Canada/United States Electricity Exchanges* (Ottawa: Minister of Supply and Services, 1979), pp. i–ii.

[113] *Ibid.*, p. 27.

[114] A kilovolt equals a thousand volts.

[115] U.S. Department of Energy, and Department of Energy, Mines and Resources Canada, *op. cit.*, p. 27.

[116] As the Executive Vice President of the Commonwealth Edison Co. of Chicago, J. J. O'Connor, explained to the U. S. Senate Committee on Finance, " . . . we, unlike most companies, have an obligation to provide service regardless. Many other industries cut back on their supplies during tight money times. They cut back on their expansion during tight money times, or if the demand for product goes down.

We, on the other hand, are obliged to continue to provide service regardless." U. S. Senate, Committee on Finance, *Hearings, Energy Conservation and Conversion Act of 1975*, 94th Cong., 1st Sess., 1975, pt. 2, p. 679.

[117] T. J. Nagel, 'Operating a Major Electric Utility Today', *Science* (1978), p. 987.

[118] U.S. Department of Energy, and Department of Energy, Mines and Resources, *op. cit.*, p. 4.

[119] Nagel, *op. cit.*, p. 986.

[120] *Ibid.*

[121] Lincoln, *op. cit.*, p. 160; E. Hirst and J. C. Moyers, 'Efficiency of Energy Use in the United States,' *Science* (1973), p. 1301; and U.S. Council on Environmental Quality, *Environmental Quality-1976* (Washington: U.S. Government Printing Office, 1976), p. 194.

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[123] *Ibid.*

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[125] *Ibid.*; H. Inhaber, *Environmental Indices* (New York: John Wiley and Sons, 1976), pp. 53–54; J. C. Esposito, *Vanishing Air* (New York: Grossman Publishers, 1970), p. 207.

[126] Neyman, *op. cit.*, p. 755.

[127] *Ibid.*, p. 754.

[128] U.S. Council on Environmental Quality, *op. cit.*, pp. 210–211.

[129] For example, see Jackson and Potworowski, *op. cit.*, pp. 68–69; A. W. Murphy (ed.), *The Nuclear Power Controversy* (Englewood Cliffs: Prentice-Hall, Inc., 1976); C. Law and R. Glen, *Critical Choice: Nuclear Power in Canada, The Issues Behind the Headlines* (Toronto: Corpus Information Services Ltd., 1978); F. H. Schmidt and D. Bodansky, *The Energy Controvery: The Fight Over Nuclear Power* (San Francisco: Albion Pub. Co., 1976); J. J. Berger, *Nuclear Power: The Unviable Option* (Palo Alto: Ramparts Press, 1976); and K. S. Shrader-Frechette, *Nuclear Power and Public Policy: The Social and Ethical Problems of Fission Technology* (D. Reidel Publ. Co., Dordrecht, Holland, 1980).

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[132] A short ton equals 2000 pounds or 0.907184 metric tons.
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[134] Schmidt and Bodansky, *op. cit.*, p. 28.
[135] *Ibid.*, p. 29.
[136] Rose, *op. cit.*, pp. 352–353.
[137] Jackson and Potworowski, *op. cit.*, p. 1.
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[139] *Ibid.*; Shrader-Frechette, *op. cit.*, p. 9.
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[141] *Ibid.*, p. 9; Rossin and Rieck, *op. cit.*, p. 588; Rose, *op. cit.*, p. 359.
[142] Rossin and Rieck, *op. cit.*, p. 588.
[143] Shrader-Frechette, *op. cit.*, p. 13; Krenz, *op. cit.*, p. 7.
[144] *Ibid.*, p. 8; Rose, *op. cit.*, p. 358. Shrader-Frechette, *op. cit.*, p. 26 has provided an excellent example of the severity of disagreement concerning estimated health risks. " ... the pro-nuclear government commission charged with regulating atomic plants calculated that 0.0002 cases of cancer per year would be induced by exposure to one rad of radiation. Biophysicist Arthur Tamplin, nuclear chemist John Gofman and others, however, calculated that 32 000 cases of cancer per year would be induced by exposure to one rad." A rad is "a unit of absorbed dose of ionizing radiation equal to an energy of 100 ergs per gram of irradiated material" (*Webster's New Collegiate Dictionary*).
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[205] *Ibid.*
[206] United Nations, *op. cit.*, p. xii.
[207] Federal Trade Commission, *op. cit.*, p. 169.
[208] *Ibid.*
[209] U. S. Senate, Committee on Finance, *op. cit.*, pp. 659–660.
[210] E. F. Osborn, 'Coal and the Present Energy Situation', *Science* (1974), p. 481.
[211] U. S. Senate, Committee on Interior and Insular Affairs, *op. cit.*, p. 46. In Volume II, Chapter 4.6 it was pointed out that occupational death rates for the mining industry were higher than those for police on duty. Sampson, *op. cit.*, p. 38 noticed that "Although the U.S. coal industry boasts the American coal miner produces five times as much as a West German and ten times as much as a Russian, U.S. mines are far more unsafe than

those in either of those two countries. Over the five years 1965–1969, twice as many miners died in the United States than in all the countries of the European economic community. And the rate was three times as bad as the rates for Britain, Poland, and Czechoslavakia."

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[431] T. H. Maugh II, 'Ozone Depletion Would Have Dire Effects', *Science* (1980), 394–395.
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[434] Esposito, *op. cit.*, p. 21.
[435] For example, Palomba, *op. cit.*, p. 69.
[436] U.S. Council on Environmental Quality, *Environmental Quality – 1976*, p. 253, Table 12–11; Environment Canada, *Air Pollution . . .* , p. 20, 22–23, Table 3.
[437] Esposito, *op. cit.*, p. 144. A review of other particulate sources may be found in the World Health Organization, *Environmental Health Criteria 8: Sulfur Oxides and Suspended Particulate Matter* (Geneva: World Health Organization, 1979), p. 32.
[438] C. R. Ross, 'National Sovereignty in International Environmental Decisions, '*Protecting the Environment: Issues and Choices – Canadian Perspectives*', (ed. by O. P. Dwivedi), (Toronto: Copp Clark Publishing, 1974), p. 269.
[439] *Ibid.*, pp. 269–270.
[440] *Ibid.*, p. 271.
[441] U.S. Council on Environmental Quality, *Environmental Quality – 1976*, p. 48.
[442] Environment Canada, *Canada Water . . .* , p. 54.
[443] U.S. Council on Environmental Quality, *Environmental Quality – 1976*, pp. 44–46.
[444] The survey areas were in Lake Michigan and Lake St. Clair.
[445] Environment Canada, *Canada Water . . .* , p. 51.
[446] H. A. Regier and W. L. Hartman, 'Lake Erie's Fish Community: 150 Years of Cultural Stresses', *Science* (1973), p. 1249.
[447] Commoner, *op. cit.*, pp. 91–92.
[448] Regier and Hartman, *op. cit.*, p. 1253.
[449] Ross, *op. cit.*, p. 274.
[450] U.S. Council on Environmental Quality, *Environmental Quality – 1976*, p. 261.
[451] Environment Canada, *Canada Water . . .* , p. 65.
[452] *Ibid.*
[453] R. C. Bocking, *Canada's Water: For Sale*? (Toronto: James Lewis and Samuel, Publisher, 1972), pp. 167–168.
[454] For example, see Volume II, Chapter 5.14 and Volume III, Chapter 8.3.
[455] Environment Canada, *Canada Water . . .* , p. 203.
[456] *Ibid.*
[457] M. Wolf, 'Solar Energy Utilization by Physical Methods', *Science* (1974), p. 382.
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[459] *Ibid.*, pp. 170–171.
[460] Recall disadvantage (13) to nuclear fission in Section 8.

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464 *Ibid.*, p. 114.
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468 *Ibid.*, p. 26. For a more recent view, see 'A Free-For-All Over Water in the West', *U.S. News and World Report*, January 8, 1979, 54–56.
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473 Sykes, *op. cit.*, p. 60.
474 *Ibid.*
475 Inhaber, *Environmental Indices*, p. 111.
476 OECD, *op. cit.*, p. 95.
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482 'America's Energy Crisis', *op. cit.*, p. 53.
483 L. J. Carter, 'Academy Energy Report Stresses Conservation', *Science* (1980), p. 385.
484 Science Council of Canada, *op. cit.*, p. 14.
485 *Ibid.*, p. 91.
486 L. J. Carter, 'Gus Speth, Planning the 'Conserver Society'', *Science* (1980), p. 1012.

TABLE 1

NONRENEWABLE NATURAL RESOURCES

1	2	3	4			5	6
RESOURCE	KNOWN GLOBAL RESERVES	STATIC INDEX (YEARS)[a]	PROJECTED RATE OF GROWTH (% PER YEAR) HIGH	AV.	LOW	EXPONENTIAL INDEX (YEARS)[b]	EXPONENTIAL INDEX CALCULATED USING 5 TIMES KNOWN RESERVES (YEARS)[c]
Aluminum	1.17×10^9 tons[d]	100	7.7	6.4	5.1	31	55
Chromium	7.75×10^8 tons	420	3.3	2.6	2.0	95	154
Coal	5×10^{12} tons	2300	5.3	4.1	3.0[e]	111	150
Cobalt	4.8×10^9 lbs	110	2.0	1.5	1.0	60	148
Copper	308×10^6 tons	36	5.8	4.6	3.4	21	48
Gold	353×10^6 troy oz	11	4.8	4.1	3.4[f]	9	29
Iron	1×10^{11} tons	240	2.3	1.8	1.3	93	173
Lead	91×10^6 tons	26	2.4	2.0	1.7	21	64
Manganese	8×10^8 tons	97	3.5	2.9	2.4	46	94
Mercury	3.34×10^6 flasks	13	3.1	2.6	2.2	13	41

TABLE 1

NONRENEWABLE NATURAL RESOURCES

7	8	9	10
COUNTRIES OR AREAS WITH HIGHEST RESERVES (% OF WORLD TOTAL)	PRIME PRODUCERS (% OF WORLD TOTAL)	PRIME CONSUMERS (% OF WORLD TOTAL)	US CONSUMPTION AS % OF WORLD TOTAL
Australia (33) Guinea (20) Jamaica (10)	Jamaica (19) Surinam (12)	US (42) USSR (12)	42
Rep. of S. Africa (75)	USSR (30) Turkey (10)		19
US (32) USSR-China (53)	USSR (20) US (13)		44
Rep. of Congo (31) Zambia (16)	Rep. of Congo (51)		32
US (28) Chile (19)	US (20) USSR (15) Zambia (13)	US (33) USSR (13) Japan (11)	33
Rep. of S. Africa (40)	Rep. of S. Africa (77) Canada (6)		26
USSR (33) S. Am. (18) Canada (14)	USSR (25) US (14)	US (28) USSR (24) W. Germany (7)	28
US (39)	USSR (13) Australia (13) Canada (11)	US (25) USSR (13) W. Germany (11)	25
Rep. of S. Africa (38) USSR (25)	USSR (34) Brazil (13) Rep. of S. Africa (13)		14
Spain (30) Italy (21)	Spain (22) Italy (21) USSR (18)		24

TABLE 1 (*continued*)

1	2	3	4			5	6
RESOURCE	KNOWN GLOBAL RESERVES	STATIC INDEX (YEARS)[a]	PROJECTED RATE OF GROWTH (% PER YEAR) HIGH	AV.	LOW	EXPONENTIAL INDEX (YEARS)[b]	EXPONENTIAL INDEX CALCULATED USING 5 TIMES KNOWN RESERVES (YEARS)[c]
Molybdenum	10.8×10^9 lbs	79	5.0	4.5	4.0	34	65
Natural Gas	1.14×10^{15} cu ft	38	5.5	4.7	3.9	22	49
Nickel	147×10^9 lbs	150	4.0	3.4	2.8	53	96
Petroleum	455×10^9 bbls	31	4.9	3.9	2.9	20	50
Platinum Group[g]	429×10^6 troy oz	130	4.5	3.8	3.1	47	85
Silver	5.5×10^9 troy oz	16	4.0	2.7	1.5	13	42
Tin	4.3×10^6 lg tons	17	2.3	1.1	0	15	61
Tungsten	2.9×10^9 lbs	40	2.9	2.5	2.1	28	72
Zinc	123×10^6 tons	23	3.3	2.9	2.5	18	50

TABLE 1 (*continued*)

7	8	9	10
COUNTRIES OR AREAS WITH HIGHEST RESERVES (% OF WORLD TOTAL)	PRIME PRODUCERS (% OF WORLD TOTAL)	PRIME CONSUMERS (% OF WORLD TOTAL)	US CONSUMPTION AS % OF WORLD TOTAL
US (58) USSR (20)	US (64) Canada (14)		40
US (25) USSR (13)	US (58) USSR (18)		63
Cuba (25) New Caledonia (22) USSR (14) Canada (14)	Canada (42) New Caledonia (28) USSR (16)		38
Saudi Arabia (17) Kuwait (15)	US (23) USSR (16)	US (33) USSR (12) Japan (6)	33
Rep. of S. Africa (47) USSR (47)	USSR (59)		31
Communist Countries (36) US (24)	Canada (20) Mexico (17) Peru (16)	US (26) W. Germany (11)	26
Thailand (33) Malaysia (14)	Malaysia (41) Bolivia (16) Thailand (13)	US (24) Japan (14)	24
China (73)	China (25) USSR (19) US (14)		22
US (27) Canada (20)	Canada (23) USSR (11) US (8)	US (26) Japan (13) USSR (11)	26

[a] The number of years known global reserves will last at current global consumption. Calculated by dividing known reserves (column 2) by the current annual consumption, (U.S. Bureau of Mines, *Mineral Facts and Problems*, 1970).

[b] The number of years known global reserves will last with consumption growing exponentially at the average annual rate of growth. Calculated by the formula

$$\text{exponential index} = \frac{1n\,((r \cdot s) + 1)}{r}$$

where r = average rate of growth from column 4
s = static index from column 3.

[c] The number of years that five times known global reserves will last with consumption growing exponentially at the average annual rate of growth. Calculated from the above formula with $5s$ in place of s.

[d] Bauxite expressed in aluminum equivalent.

[e] U.S. Bureau of Mines contingency forecasts, based on assumption that coal will be used to synthesize gas and liquid fuels.

[f] Includes U.S. Bureau of Mines estimates of gold demand for hoarding.

[g] The platinum group metals are platinum, palladium, iridium, osmium, rhodium, and ruthenium.

Source: U.S. House of Representatives, Committee on Merchant Marine and Fisheries, Subcommittee on Fisheries and Wildlife Conservation and the Environment, *Growth and Its Implications for the Future, Part I: Hearing with Appendix*. 93rd Cong., 1st Sess., May 1, 1973, Serial No. 93–7, pp. 108–112.

TABLE 2

COMMERCIAL ENERGY*

	TOTAL PRODUCTION		TOTAL CONSUMPTION		PER CAPITA CONSUMPTION	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	129.40	1653.45	129.80	1701.57	6715	8867
1965	139.13	1711.79	139.21	1782.91	7074	9176
1966	141.55	1813.93	146.39	1903.41	7301	9684
1967	152.70	1912.34	154.35	1941.46	7562	9770
1968	165.89	1975.84	164.98	2061.66	7959	10272
1969	184.03	2054.75	176.42	2177.84	8389	10745
1970	210.92	2169.90	185.65	2257.88	8708	11020
1971	228.27	2138.37	194.29	2307.79	8997	11146
1972	261.15	2179.68	206.85	2417.89	9468	11577
1973	291.27	2162.36	214.33	2504.04	9687	11901
1974	282.92	2105.81	220.65	2433.48	9816	11484

* The total figures are sums of energy produced and consumed in millions of metric tons of coal equivalent for coal and lignite, crude petroleum and natural gas liquids, natural gas, and hydro and nuclear electricity. Per capita consumption figures are in kilograms.

Source: United Nations, *World Energy Supplies 1950–1974* (Statistical Papers, Series J, No. 19), New York, 1976, pp. 42–43, T2.

CHART 1

PER CAPITA CONSUMPTION OF ENERGY
IN KILOGRAMS OF COAL EQUIVALENT

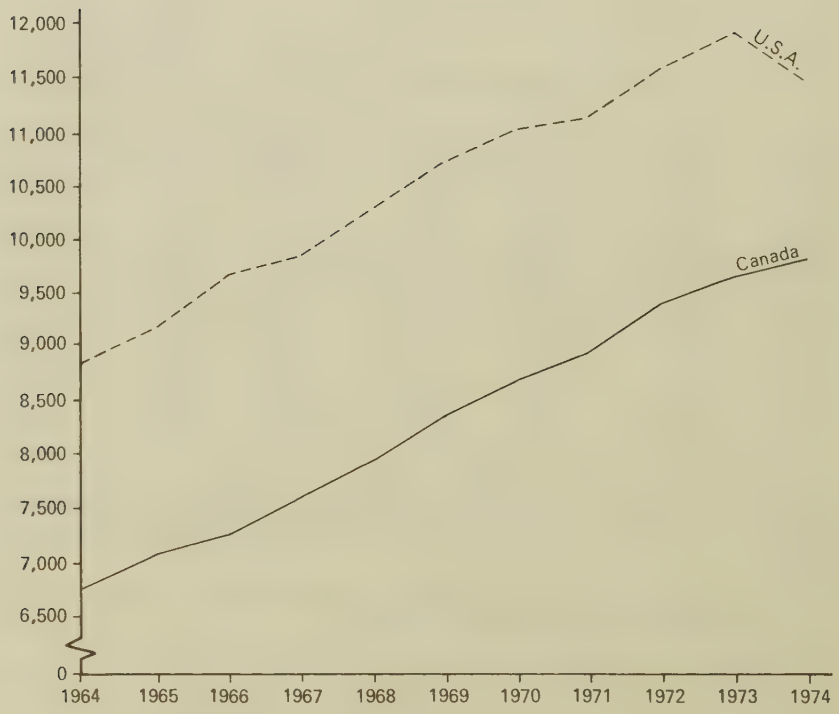


TABLE 3

COMMERCIAL ENERGY RATIOS

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	0.99	0.97	0	0
1965	0.99	0.96	0	–1.0
1966	0.97	0.95	–2.0	–2.1
1967	0.98	0.99	–1.0	2.1
1968	1.00	0.96	1.0	–1.0
1969	1.04	0.94	5.0	–3.1
1970	1.14	0.96	15.2	–1.0
1971	1.18	0.93	19.2	–4.1
1972	1.26	0.90	27.2	–7.2
1973	1.36	0.86	37.4	–11.3
1974	1.28	0.87	29.3	–10.3

Source: See Commercial Energy table.

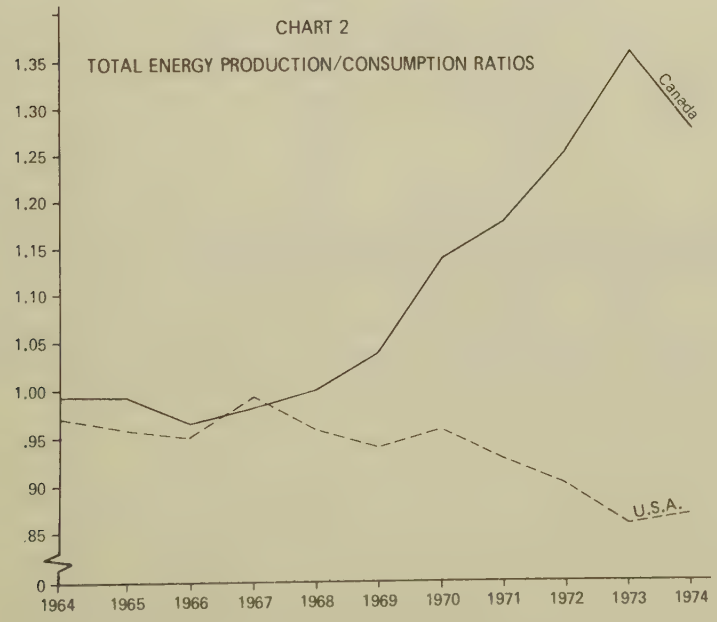


TABLE 4

PRODUCTION CONCENTRATION RATIOS FOR THE FOUR MAJOR FUELS AND FOR THE COMBINED ENERGY MARKET, 1955, 1960, 1965, 1970

(Percent)

CONCENTRATION RATIO	INDUSTRY[1]	1955	1960	1965	1970
4-Firm	Crude oil	21.2	23.9	27.9	31.0
	Natural gas	18.6	16.7	18.9	24.4
	Coal	17.8	21.4	26.5	30.7
	Uranium	77.9	51.4	55.4	55.3
	Energy (B.t.u.'s)	12.6	12.5	15.6	19.0
	Energy (Dollars)	16.1	17.7	20.9	23.4
8-Firm	Crude oil	35.9	38.2	44.6	49.1
	Natural gas	30.4	27.7	31.2	39.1
	Coal	25.4	30.5	36.3	41.2
	Uranium	99.1	72.4	79.3	80.0
	Energy (B.t.u.'s)	22.0	22.5	26.1	31.6
	Energy (Dollars)	27.2	29.1	34.0	37.8
20-Firm	Crude oil	55.7	57.6	63.0	69.0
	Natural gas	48.1	44.4	48.6	57.6
	Coal	39.5	44.5	50.1	56.4
	Uranium	100.0	99.6	100.0	100.0
	Energy (B.t.u.'s)	38.1	39.4	43.2	51.1
	Energy (Dollars)	43.3	47.4	50.8	57.2

[1] Note: Natural gas production includes U.S. and Canada. Uranium concentration is measured at the milling stage.

Source: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 148, Table VIII–I.

TABLE 5

FOUR-FIRM CONCENTRATION RATIOS IN VARIOUS INDUSTRIES, 1970

INDUSTRY	FOUR-FIRM CONCENTRATION RATIO (Percent)
Gold Mining	79.9
Copper Mining	74.8
Sulfur Mining	72.0[a]
Iron Ore Mining	63.6
Lead and Zinc Mining	47.0
Manufacturing	40.1
Crude Oil	31.0
Natural Gas[b]	24.4
Coal	30.7
Uranium[c]	55.3
Energy (B.t.u.)	19.0
Energy (dollars)	23.4

[a] 1971 data.
[b] Includes Canadian production.
[c] Milling concentration.

Source: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 139, Table VII–23 and Table VII–24.

TABLE 6

PRODUCTION OF ELECTRICITY, BY TYPE

(thousand million kilowatt hours)

	TOTAL		THERMAL		HYDRO		NUCLEAR	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1964	134.99	1083.74	21.50	899.89	113.34	180.51	0.14	3.34
1965	144.27	1157.58	27.09	956.75	117.06	197.17	0.12	3.66
1966	158.14	1249.44	28.14	1045.80	129.83	198.13	0.16	5.52
1967	165.63	1317.30	32.73	1084.38	132.75	225.27	0.14	7.66
1968	176.38	1436.03	40.55	1197.19	134.97	226.31	0.86	12.53
1969	191.10	1552.76	41.36	1284.75	149.25	254.08	0.49	13.93
1970	204.72	1639.77	47.05	1366.75	156.71	251.22	0.97	21.80
1971	216.47	1717.52	51.50	1409.49	160.98	270.13	3.99	37.90
1972	240.21	1853.39	53.53	1521.78	179.95	277.58	6.74	54.03
1973	263.33	1964.83	56.24	1604.20	192.84	277.30	14.26	83.33
1974	278.95	1967.29	54.93	1548.19	210.16	306.41	13.86	112.70

PERCENTS

	THERMAL		HYDRO		NUCLEAR	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	15.9	83.0	84.0	16.7	0.1	0.3
1965	18.8	82.7	81.1	17.0	0.1	0.3
1966	15.3	83.7	82.1	15.9	0.1	0.4
1967	19.8	82.3	80.2	17.1	0.1	0.6
1968	23.0	83.4	76.5	15.8	0.5	0.9
1969	21.6	82.7	78.1	16.4	0.3	0.9
1970	23.0	83.4	76.7	15.3	0.5	1.3
1971	23.8	82.1	74.4	15.7	1.8	2.2
1972	22.3	82.1	74.9	15.0	2.8	2.9
1973	21.4	81.7	73.2	14.1	5.4	4.2
1974	19.7	78.7	75.3	15.6	5.0	5.7

Source: United Nations, *World Energy Supplies 1950–1974* (Statistical Papers, Series J, No. 19), New York, 1976, p. 723, T20.

FIGURE 1

1974

PRODUCTION OF ELECTRICITY, BY TYPE

(Percents)

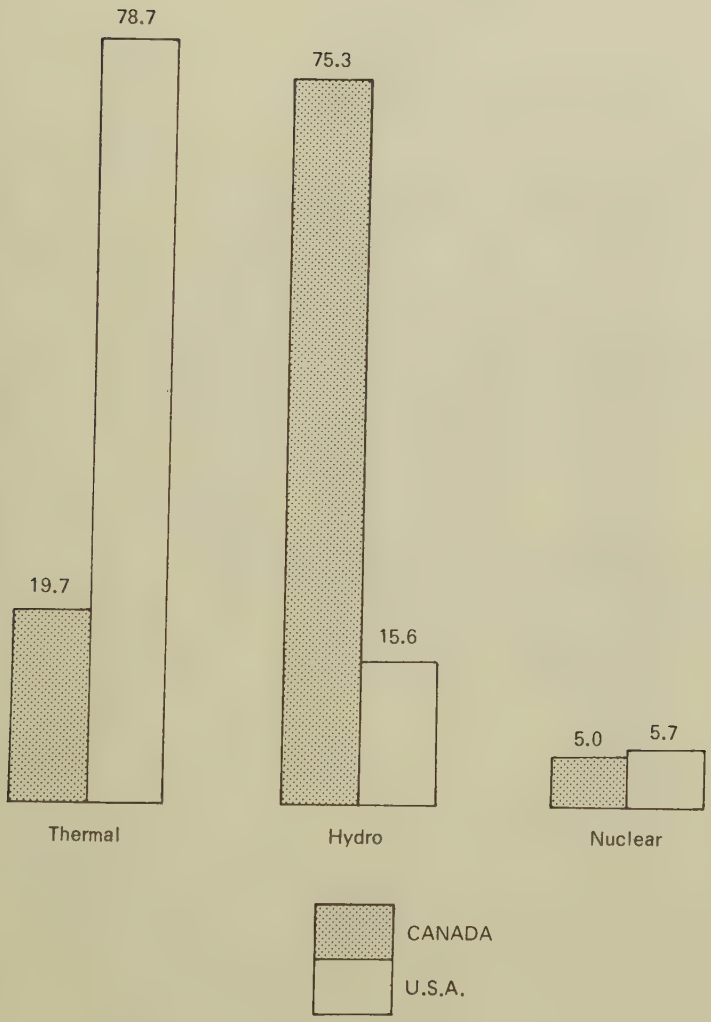


TABLE 7

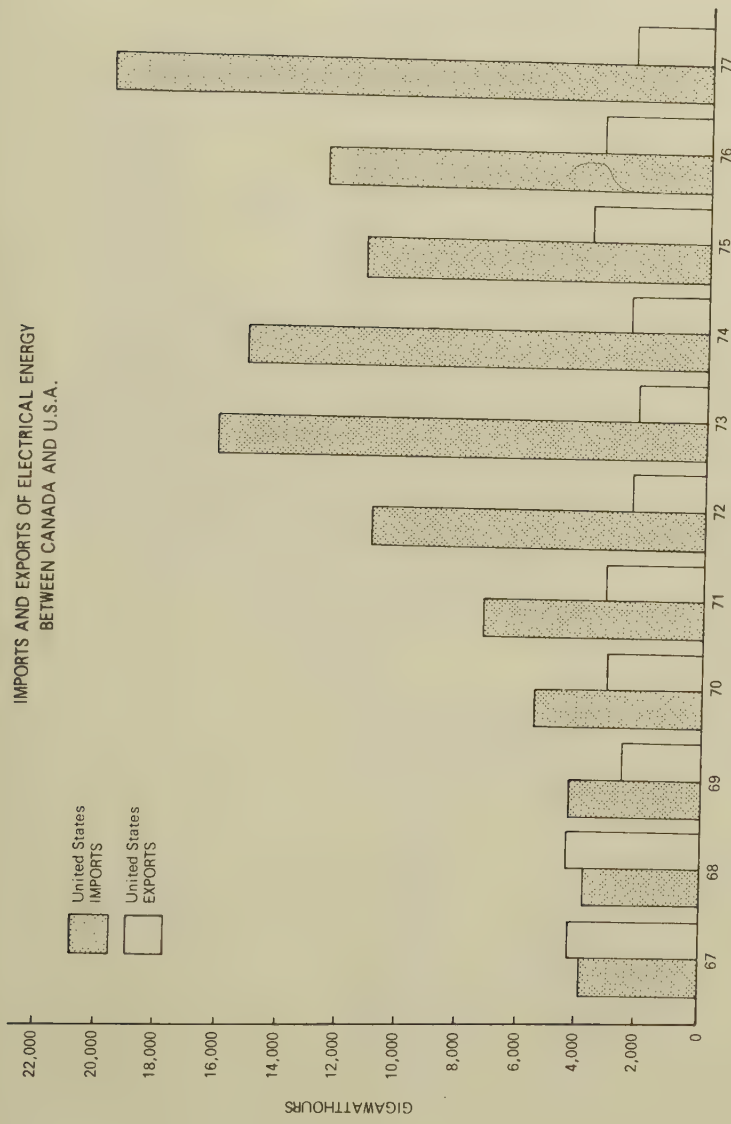
ELECTRICITY
(million KWh)

	PRODUCTION		CONSUMPTION		PRODUCTION/ CONSUMPTION RATIO	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	137 635	1 148 785	136 597	1 150 740	1.01	1.00
1965	147 349	1 226 795	147 240	1 226 652	1.00	1.00
1966	161 414	1 323 749	160 235	1 324 841	1.01	1.00
1967	169 253	1 396 014	169 441	1 395 715	1.00	1.00
1968	180 626	1 522 998	181 089	1 522 367	1.00	1.00
1969	195 524	1 646 242	193 944	1 647 314	1.01	1.00
1970	209 651	1 739 796	207 265	1 741 756	1.01	1.00
1971	221 966	1 821 573	218 375	1 825 103	1.02	1.00
1972	246 231	1 966 560	237 575	1 974 594	1.04	1.00
1973	269 057	2 071 070	254 340	2 079 570	1.06	1.00
1974	284 800	2 093 122	271 843	2 105 816	1.05	0.99

Sources: OECD, *Statistics of Energy 1959–73*, Paris 1973, p. 167, T21, p. 185, T21; *1960–1974*, pp. 143, 149.

FIGURE 2

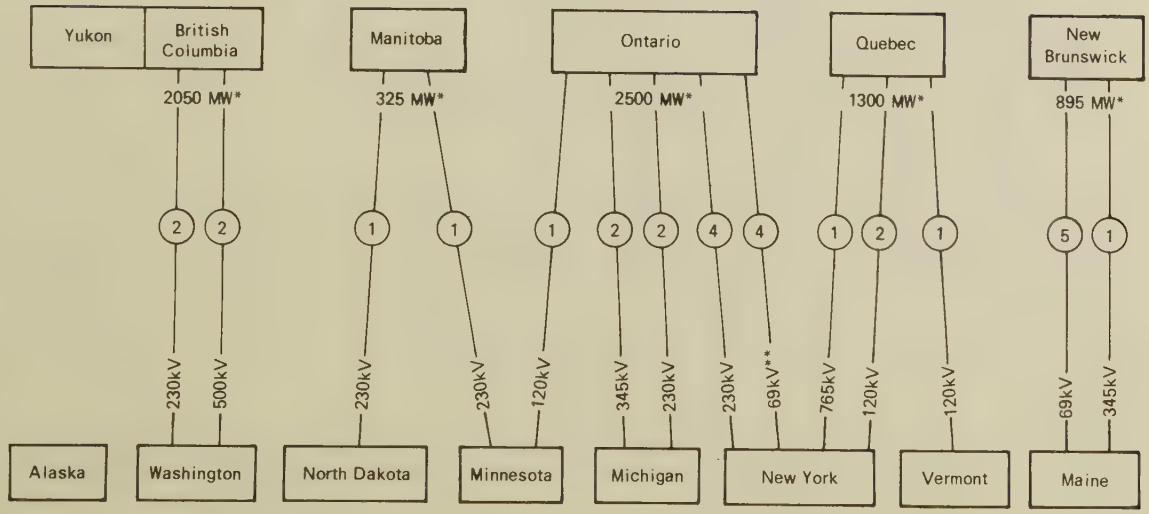
IMPORTS AND EXPORTS OF ELECTRICAL ENERGY
BETWEEN CANADA AND U.S.A.



Source: U.S. Department of Energy, and Energy, Mines and Resources, Canada, Canada/United States Electricity Exchanges (Ottawa: Minister of Supply and Services, 1979) p.28, Figure 2-1.

FIGURE 3

EXISTING INTERNATIONAL POWER LINES - 69kV AND ABOVE
GEOGRAPHIC DISTRIBUTION



*Estimated Power Transfer Capability.

**Two of these lines have a power transfer capability of 75 megawatts (25Hz).

Source: U.S. Department of Energy, and Energy, Mines and Resources Canada, Canada/United States Electricity Exchanges (Ottawa: Minister of Supply and Services, 1979) p. 6, Figure 1-2.

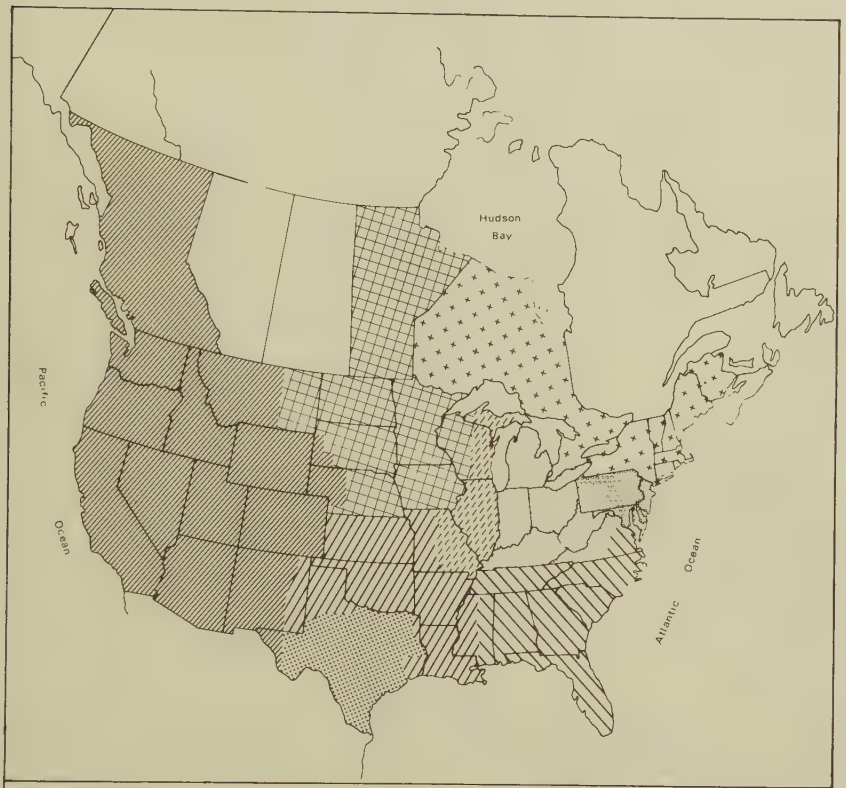


FIGURE 4

Regional Electric Reliability Councils

ECAR
East Central Area
Reliability Coordination
Agreement

MAIN
Mid America
Interpool Network

SERC
Southeastern Electric
Reliability Council

ERCOT
Electric Reliability
Council of Texas

MARCA
Mid-Continent Area
Reliabilty Coordination
Agreement

SPP
Southwest Power Pool

MAAC
Mid-Atlantic Area
Coordination Group

NPCC
Northeast Power
Coordinating Council

WSCC
Western Systems
Coordinating Council

Source: U.S. Department of Energy, and Energy, Mines and Resources Canada, Canada/United States Electricity Exchanges (Ottawa: Minister of Supply and Services, 1979) p.34, Figure 2-2.

TABLE 8

ESTIMATED SOURCES OF FUEL FOR ELECTRICITY GENERATION IN SELECTED REGIONS, 1979

REGION[a]	FUEL USE BY PERCENTS			
	HYDRO	OIL/GAS	COAL	NUCLEAR
Northeast Power Co-ord. Council	14	51	11	24
East Central Area	0	5	89	6
Mid-Continent Area	12	2	60	26
Western Systems[b]	37	32	24	6
Maritime Provinces[c]	55	36	9	0
Quebec	99	1	0	0
Ontario	44	11	26	19
Manitoba	90	1	9	0
Saskatchewan	33	10	57	0
Alberta	12	30	58	0
British Columbia	95	5	0	0

[a] See map in Figure 4 for regions.

[b] 1% geothermal generation.

[c] Does not include Newfoundland's exports to Quebec.

Source: U.S. Department of Energy, and Energy, Mines and Resources, *Canada/United States Electricity Exchanges* (Ottawa: Minister of Supply and Services, 1979), p. 50, Figure 2—7.

TABLE 9

URANIUM OXIDE PRODUCTION

	SHORT TONS U_3O_8		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	7285	12529	0	0
1965	4443	10341	–39.0	–17.5
1966	3932	10589	–46.0	–15.5
1967	3738	11253	–48.7	–10.2
1968	3932	12368	–46.0	–1.3
1969	3854	11609	–47.1	–7.3
1970	4104	12905	–43.7	3.0
1971	4107	12273	–43.6	–2.0
1972	4881	12900	–33.0	3.0
1973	4759	13235	–34.7	5.6
1974	4795	11528	–34.2	–8.0

Sources: U.S. House of Representatives, Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power, *Energy Information Digest*, USGPO July 1977, p. 63, T36.
Statistics Canada, *General Review of the Mineral Industries* (26–201) *1964 and 1965*, p. A-5, T1; *1966 and 1967*, p. A–5, T1; *1968*, p. 7, T1A; *1969*, p. 15, T1C; *1972*, p. 7, T1A, p. 11, T1B, p. 15, T1C; *1975*, p. 9, T1A, p. 17, T1B.

TABLE 10

GOVERNMENT FUNDING FOR CIVIL NUCLEAR R & D

	AS % OF TOTAL GOVERNMENT R & D EXPENDITURE		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	19.4	5.9	0	0
1965	16.7 (0.6)*	5.4 (0.7)	–13.9	–8.4
1966	19.1	5.1	–1.5	–13.5
1967	23.9	5.7	23.1	–3.3
1968	18.8	NA	–3.0	NA
1969	17.6	5.5	–9.2	6.7
1970	18.0 (0.6)	5.7 (0.4)	–7.2	–3.3
1971	15.2	5.1	–21.6	–13.5

* Figures in parentheses are percents of total government expenditure.

Sources: OECD, *Changing Priorities for Government R & D*, Paris, 1975, p. 296, T1.
National Science Board, *Science Indicators 1976*, pp. 186–187, T1–3.

TABLE 11

GOVERNMENT FUNDING FOR CIVIL NUCLEAR R & D
(millions of dollars)

	CURRENT DOLLARS			CONSTANT 1964 US DOLLARS	
	CANADA	CANADA IN US DOLLARS	USA	CANADA	USA
1964	45.9	42.6	891.1	42.6	891.1
1965	48.1	44.7	871.0	43.3	843.5
1966	63.9	59.4	875.0	56.1	825.1
1967	75.6	70.1	986.8	64.1	901.3
1968	87.8	81.5	NA	71.6	NA
1969	87.6	81.4	873.5	68.2	731.9
1970	98.6	94.5	912.9	75.1	725.3
1971	87.3	86.5	838.0	65.7	635.7

	1964 US DOLLARS PER CAPITA FUNDING		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2.21	4.64	0	0
1965	2.20	4.34	–0.4	–6.4
1966	2.80	4.20	26.6	–9.4
1967	3.15	4.54	42.5	–2.1
1968	3.46	NA	56.5	NA
1969	3.25	3.61	47.0	–22.1
1970	3.53	3.54	59.7	–23.7
1971	3.05	3.07	38.0	–33.8

Source: National Science Board, *Science Indicators 1976*, pp. 186–187, T1–3.

TABLE 12

WORLD NUCLEAR POWER CAPACITY IN OPERATION, AS OF 31 DECEMBER 1975 AND PROJECTED FOR 1980

COUNTRY	TOTAL NUCLEAR POWER CAPACITY 1975 MW_E (NET)	NUMBER OF POWER REACTORS 1975 (> 20 MW_E)	TOTAL NUCLEAR POWER CAPACITY 1980 MW_E (NET)	NUMBER OF POWER REACTORS 1980* (> 20 MW_E)	THEORETICAL CAPACITY FOR 20 KT ATOMIC BOMB PRODUCTION 1980 (BOMBS/YEAR)
Argentina	319	1	919	2	25
Austria	—	—	692	1	15
Belgium	1 650	3	3 446	5(1)	85
Brazil	—	—	626	1	15
Bulgaria	864	2	1 728	4	45
Canada	2 539	7	7 802	15	200
Czechoslovakia	110	1	1 838	5(3)	45
Finland	—	—	1 500	3	35
France	2 706	10	14 462	22	—
German DR	926	3	1 786	5	45
Germany, FR	4 060	8	13 320	18	330
Hungary	—	—	864	2	20
India	587	3	1 229	6	30
Iran	—	—	1 200	1	30
Italy	542	3	1 422	5	35
Japan	6 287	12	19 066	28(4)	450
Korea, South	—	—	1 769	3(2)	45
Mexico	—	—	1 308	2	30
Netherlands	499	2	499	2	12
Pakistan	125	1	125	1	3
Romania	—	—	432	1(1)	10
Spain	1 073	3	8 365	11(1)	210
Sweden	3 184	5	8 264	11(1)	210
Switzerland	1 006	3	5 933	8(4)	150
Taiwan	—	—	2 158	3	50
UK	4 539	29	10 697	39	—
USA	36 593	54	86 690	103(5)	—
USSR	5 464	18	19 624	36	—
Yugoslavia	—	—	1 400	2(1)	35

Totals	1975	1980	Total theoretical bomb production capacity in non-nuclear-weapon countries 1980	2–200 bombs/year
Countries†	19	29		
Reactors	168	345		
Capacity (MW_e)	73 073	219 164		

* The numbers in brackets indicate the number of reactors included in the total figure for reactors planned for operation in 1980 but not under construction as of 31 December 1975.

† The People's Republic of China has constructed one or two power reactors but only to supply electricity for its military uranium-enrichment plant.

Source: F. C. Barnaby, 'How States Can 'Go Nuclear' ', *The Annals of the American Academy of Political and Social Science* (1977), 430, p. 34, Table 1.

TABLE 13

EFFECTIVE TAX RATES PAID BY 10 MAJOR OIL COMPANIES, 1964 TO 1974 – INCLUDES ALL TAXES, OTHER THAN EXCISE TAXES, PAID TO FEDERAL, STATE, LOCAL, AND FOREIGN GOVERNMENTS

(In Percent)

	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964
Total:											
Exxon	81.8	78.1	79.8	76.9	77.8	76.3	75.5	76.5	76.4	76.4	74.9
Gulf	75.2	67.2	70.2	63.7	55.5	50.2	45.3	47.5	46.4	45.0	43.2
Mobil	73.9	62.4	63.2	63.9	57.1	55.4	54.1	49.6	48.5	49.1	47.8
Phillips[1]	60.8	44.5	51.9	47.5	46.8	42.5	42.2	41.9	42.3	36.2	34.4
Shell	43.6	43.6	45.6	43.7	46.0	39.1	36.8	36.1	38.0	38.0	35.7
Standard of California	61.9	59.2	65.1	63.6	60.5	55.8	52.9	48.4	32.5	30.6	31.2
Standard of Indiana	54.3	46.6	43.0	40.9	41.1	39.7	42.0	40.9	39.8	44.5	39.1
Standard of Ohio	41.5	50.1	56.6	35.6	29.2	58.8	47.2	43.8	44.1	50.5	48.5
Sun	62.3	54.1	55.4	54.2	57.0	53.0	48.4	NA	NA	NA	NA
Texaco	85.6	74.3	75.3	70.5	66.8	66.6	63.0	61.9	NA	NA	NA
10-company average[2]	76.9	70.3			66.6			62.4			55.8
United States:											
Gulf	40.5	41.0	28.5	30.7	31.6	26.9	19.4	29.6	33.3	30.9	33.1
Mobil	42.6	41.5	38.9	45.9	44.1	38.9	34.7	39.7	39.4	42.7	43.3
Phillips[1]	46.9	50.0	48.6	52.8	50.5	45.3	45.8	45.1	43.1	38.7	39.9
Shell	44.1	44.0	45.7	44.0	46.1	38.3	36.2	35.8	36.9	36.5	34.5
Standard of California	44.1	49.2	44.8	45.6	44.6	34.9	36.3	36.5	37.5	34.6	36.8
Standard of Indiana	46.5	41.6	46.0	48.1	48.1	44.2	48.3	40.6	39.3	42.0	34.7
Standard of Ohio	29.2	48.5	56.2	31.0	26.6	59.4	46.7	43.0	43.0	50.4	47.8
Sun	48.4	50.5	47.7	47.5	48.3	42.0	37.7	NA	NA	NA	NA
Texaco	48.3	37.2	35.6	35.3	36.6	30.3	25.7	25.3	NA	NA	NA
Exxon	44.5	42.3	40.8	41.3	43.7	40.2	40.5	39.3	38.5	37.4	35.1
10-company average[2]	44.8	42.9			42.4			35.6			31.6
Foreign:											
Exxon	87.2	83.7	87.0	84.4	85.4	85.4	83.1	84.4	83.8	82.7	81.3
Gulf	81.7	72.1	88.0	79.1	73.2	69.6	67.0	67.9	63.8	63.4	56.8
Mobil	79.8	67.9	71.3	71.3	65.5	67.0	66.4	57.8	54.7	53.7	50.4
Phillips[3]	80.3										
Shell[4]	49.8										
Standard of California	67.2	61.4	71.2	69.3	67.4	66.0	61.7	55.6	26.2	25.2	23.5
Standard of Indiana[3]	66.9	61.3	22.1	10.1	4.8			57.7	95.7		
Standard of Ohio[4]	73.5										
Sun[3]	79.1	59.2	77.6	77.1	93.0			NA	NA	NA	NA
Texaco	88.8	80.5	84.6	80.5	79.3	79.4	81.6	80.4	NA	NA	NA
10-company average[2]	84.5	77.8			79.4			78.2			70.4

[1] The rates of profitability of taxes for Phillips were recalculated using the tax and income figures supplied by Phillips; however, Phillips points out that the income shown includes earnings of companies accounted for by the equity method, whereas the tax figures do not include taxes paid by such companies. Hence, the taxes are understated.

[2] This average includes total company income and total taxes paid by the companies.

[3] These companies had losses on foreign operations in certain parts not shown.

[4] Foreign operations of these companies are, or were, relatively insignificant, i.e., less than 5% of net assets.

Note: Data in this table were supplied by the 10 major oil companies in response to a questionnaire from the Senate Finance Committee asking for data from petroleum operations. Five of the companies reported profits on petroleum operations as requested, 5 companies reported total corporate profit data. Four of the 5 companies reporting total profit data, Mobil, Gulf, Shell, and Standard of California, all indicated that the nonpetroleum portion of their business was relatively insignificant and its inclusion should not therefore create any distortions in the data.

Sources: Responses from the 10 major oil companies listed above to a questionnaire from the Senate Finance Committee asking for the rate of profitability to taxes, other than excise taxes. The responses to this question showed net income, taxes (other than excise taxes), and the ratio between net income after tax and the sum of net income after taxes and taxes (other than excises) paid to Federal, State and local governments and to foreign governments. The reciprocal of this ratio is the ratio between total taxes (other than excises), paid to Federal, State and local governments and to foreign governments, and the sum of such taxes and after-tax net income, i.e., the effective overall tax rate paid by the 10 companies to all governments. This reciprocal is shown above in the tables. Caution: This is not the effective tax rate paid to the U.S. Government.

U.S. Senate, Committee on Finance, Subcommittee on Energy, *Hearing, Depletion Allowance*, 94th Cong., 1st Sess., March 17, 1975, p. 19, Table 3; U.S. Senate Committee on Finance, *1974 Profitability of Selected Major Oil Company Operations* (Washington: U.S. Government Printing Office, 1975), pp. 6–7, Table 3.

TABLE 14

CRUDE PETROLEUM
(thousand metric tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	40 429	375 690	46 033	435 140
1965	42 534	384 010	47 360	445 620
1966	46 519	408 170	49 197	465 300
1967	50 023	433 510	52 526	483 560
1968	53 919	448 790	56 463	509 500
1969	58 862	454 540	58 422	524 270
1970	66 126	474 310	62 907	539 700
1971	70 615	469 260	68 821	558 240
1972	83 780	466 937	75 770	585 397
1973	93 786	452 729	82 346	619 623
1974	88 259	432 109	86 655	602 847

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	0.88	0.86	0	0
1965	0.90	0.86	2.2	0.0
1966	0.95	0.88	7.9	2.3
1967	0.95	0.90	7.9	4.6
1968	0.95	0.88	7.9	2.3
1969	1.01	0.87	14.7	1.1
1970	1.05	0.88	19.3	2.3
1971	1.03	0.84	17.0	–2.3
1972	1.11	0.80	26.1	–7.0
1973	1.14	0.73	29.5	–15.1
1974	1.02	0.72	15.9	–16.2

Sources: OECD, *Statistics of Energy 1959–1973*, Paris 1973, p. 158, T11, p. 176, T11; *1960–1974*, pp. 143, 149.

CHART 3

CRUDE PETROLEUM PRODUCTION/CONSUMPTION RATIOS

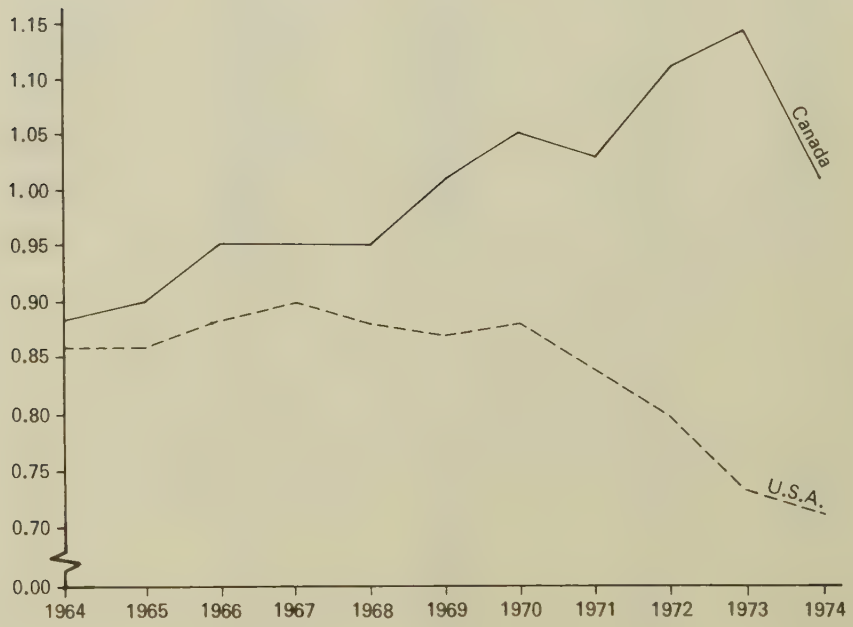


TABLE 15

THE 20 LARGEST AMERICAN CRUDE OIL PRODUCERS, 1970

CRUDE RANK	COMPANY	NET CRUDE PRODUCTION (THOUSAND BARRELS PER YEAR)	NET PRODUCTION AS A PERCENT OF TOTAL U.S. PRODUCTION
1	Exxon Corp.	299 139	8.50
2	Texaco, Inc.	262 800	7.47
3	Gulf Oil	198 524	5.64
4	Shell Oil Co.	194 023	5.52
5	Standard Oil Co. Calif.	162 425	4.62
6	Standard Oil Co. Ind.	147 000	4.18
7	Atlantic Richfield Co.	129 260	3.67
8	Mobil Oil	119 873	3.41
9	Union Oil Co. of Calif.	101 069	2.87
10	Getty Oil	100 901	2.87
11	Sun Oil Co.	78 441	2.23
12	Continental Oil	64 240	1.83
13	Marathon Oil	59 624	1.70
14	Phillips Petroleum	50 699	1.44
15	Cities Service Co.	43 764	1.24
16	Amerada-Hess	32 861	0.93
17	Tenneco	27 255	0.77
18	Superior Oil	19 801	0.56
19	Champlin (Union Pacific)	18 338*	0.52
20	Signal Cos.	13 341	0.38
	Total (Top 20)	2 123 378	60.37
	Total U.S.	3 517 450	
	Concentration Ratios: (Percent)		
	4 firm 27.14		
	8 firm 43.02		
	20 firm 60.37		

* Includes Canadian crude production.

Source: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 192, Table B—4.

TABLE 16

THE 21 LARGEST CANADIAN CRUDE OIL PRODUCERS, 1970

RANK IN CANADIAN PRODUCTION	PARENT COMPANY – FOREIGN SUBSIDIARY	NET CRUDE PRODUCTION (THOUSAND BARRELS PER YEAR)	NET CRUDE PRODUCTION AS % OF TOTAL CAN. PRODUCTION	RANK IN AMERICAN PRODUCTION
1	Exxon Corp. -- Imperial Oil	62050	11.52	1
2	Texaco Inc.[a]	40880	7.59	2
3	Mobil Oil	38690	7.18	8
4	Gulf Oil	33653	6.25	3
5	Shell Canada	24711	4.58	4
6	Standard Oil of California – Chevron Standard	22922	4.25	5
7	Hudson Bay Oil and Gas	21973	4.08	c
8	Standard Oil of Indiana – Amoco	20696	3.84	6
9	Phillips Petroleum – Pacific Petroleum[b]	19236	3.57	14
10	Atlantic Richfield	13140	2.44	7
11	Union Oil of California	12045	2.23	10
12	Superior Oil Co. – Canadian Superior	11206	2.08	19
13	Central Del Rio	9709	1.80	c
14	Husky Oil	9381	1.74	c
15	Aquitaine	7665	1.42	c
16	Home Oil	6935	1.28	c
17	Sohio-BP-BP Oil	6789	1.26	25
18	Dome Petroleum	6497	1.20	c
19	Petrofina	6205	1.15	c
20	Ashland Oil Canada	5402	1.00	32
21	Sun Oil	5220	0.06	c
	Total Top 21	385002	71.50	
	Total Canadian	538448	100.00	
	Top 4 Can. (all U.S. firms)	175273	32.55	
	13 U.S. firms	311222	57.80	

[a] Gross production.

[b] Phillips Petroleum owns 48% of Pacific Petroleum.

[c] Canadian owned.

Sources: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 163, Table A–6.

TABLE 17

NATURAL GAS (except blast furnace)

teracalories (10^9 Kcal)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	315 046	3 976 476	170 184	4 052 748
1965	344 480	4 127 214	192 734	4 208 610
1966	368 285	4 435 410	215 561	4 536 210
1967	399 361	4 670 904	228 850	4 748 646
1968	446 300	4 955 034	257 040	5 075 700
1969	509 834	5 309 682	288 091	5 454 876
1970	586 732	5 622 204	324 904	5 714 184
1971	630 042	5 763 786	340 015	5 898 186
1972	722 194	5 938 170	387 458	6 147 498
1973	780 730	6 034 686	429 114	6 253 212
1974	760 960	5 443 332	416 600	5 644 638

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	1.85	0.98	0	0
1965	1.79	0.98	−3.2	0.0
1966	1.71	0.98	−7.6	0.0
1967	1.38	0.98	−25.4	0.0
1968	1.74	0.98	−6.0	0.0
1970	1.77	0.97	−4.3	−1.0
1970	1.81	0.98	−2.2	0.0
1971	1.85	0.98	0.9	0.0
1972	1.86	0.98	0.6	−1.0
1973	1.82	0.97	−1.6	−1.0
1974	1.83	0.96	−1.1	−2.0

Sources: OECD, *Statistics of Energy 1959–1973*, Paris 1973, p. 156, T8; p. 174, T8; *1960–1974*, pp. 142, 148.

CHART 4

NATURAL GAS PRODUCTION/CONSUMPTION RATIOS

TABLE 18

CANADIAN NATURAL GAS COMPANIES (1970)

RANK	COMPANY	PRODUCTION BILLION CU.FT. (PER DAY)	PRODUCTION BILLION CU.FT. (PER YEAR)	PARENT COMPANY
1	Gulf Oil	394	143 810	Gulf Oil Corp.
2	Shell Canada	392	143 080	Shell Oil Co.
3	Pacific Petroleums	377	137 605	Pacific Petroleums[1]
4	Imperial Oil	349	127 583	Exxon Corp.
5	Hudson's Bay O & G	317	115 705	Continental Oil
6	Amoco	278	101 470	Standard Oil, Indiana
7	Chevron Standard	179	65 335	Standard Oil, California
8	Mobil Oil	171	62 415	Mobil Oil Corp.
9	Central — Del Rio	162	59 130	Canadian Pacific Investment, Ltd.
10	Canadian Superior	139	50 735	Superior Oil Co.
11	Dome Petroleum	148	54 020	Dome Petroleum[2]
12	Home Oil	89	32 485	Home Oil, Ltd.
13	Petrofina	88	32 120	Petrofina, S.A. (Belgium)
14	BP Oil	62	22 630	Standard Oil, Ohio
15	Atlantic Richfield	59	21 535	Atlantic Richfield Co.
16	Union Oil	41	14 965	Union Oil Co., California
17	Husky Oil	34	12 410	Husky Oil, Ltd.
18	Aquitaine	21	7 665	Societe Nationale Des Petroles[3]
19	Ashland Oil Canada	17	6 205	Ashland Oil and Refining
	Total Canadian Production	5004	1 826 460	

CR_4 = 30.2%
CR_8 = 49.1%
CR_{16} = 64.8%
CR_{19} = 66.3%

[1] 48% owned by Phillips Petroleum Co.
[2] 18% owned by Dome Mines, Ltd.
[3] 51% owned by Enterprises de Recherches et d'Activities Petrolieres (Fr.)
Note: The production figure for Texaco was not available. As a consequence, the concentration ratios are biased downward somewhat.

Source: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 168, Table A–9.

TABLE 19

THE 20 LARGEST NATURAL GAS PRODUCERS, U.S. AND CANADA, 1970

NATURAL GAS PRODUCTION RANK	FIRM	NATURAL GAS PRODUCTION[1] (MILLION CUBIC FEET)	PERCENT OF TOTAL PRODUCTION[2]
1	Exxon Corp.	2 144 010	8.9
2	Texaco, Inc.	1 387 000[3]	5.7
3	Standard Oil Co. Ind.	1 220 925	5.0
4	Gulf Oil Corp.	1 150 115	4.7
5	Mobil Oil Corp.	1 102 665	4.6
6	Shell Oil Co.	1 073 100	4.4
7	Atlantic Richfield Co.	750 440	3.1
8	Phillips Petroleum Co.	636 925	2.6
9	Standard Oil Co. Calif.	603 080	2.5
10	Union Oil Co. of Calif.	584 475	2.4
11	Sun Oil Co.	518 300	2.1
12	Getty Oil Co.	439 832	1.8
13	Continential Oil Co.	423 765	1.7
14	Superior Oil Co.	389 571	1.6
15	Cities Service Co.	378 177	1.6
16	Tenneco Corp.	334 158	1.4
17	El Paso Natural Gas Co.	219 730	0.9
18	Pennzoil United, Inc.	212 150	0.9
19	Amerada-Hess Corp.	191 512	0.8
20	Marathon Oil Co.	174 056	0.7
	Total, Top 20	13 933 986	57.5
	Total marketed production, U.S. and Canada	24 215 920	100.0
	Concentration Ratios:	(Percent)	
	4 firm	24.4	
	8 firm	39.1	
	20 firm	57.5	

[1] Gas output definitions vary among firms.
[2] Detail does not add to total because of rounding.
[3] U.S. production only.

Source: U.S. Federal Trade Commission, *Concentration Levels and Trends in the Energy Sector of the U.S. Economy* (Washington: U.S. Government Printing Office, 1974), p. 215, Table C–6.

TABLE 20

HARD COAL

(thousand metric tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	8 480	454 718	20 939	401 986
1965	8 641	475 291	22 424	425 882
1966	8 450	492 556	22 210	448 390
1967	8 517	508 388	21 665	442 085
1968	7 904	500 673	22 549	457 936
1969	7 849	513 444	21 930	464 259
1970	11 596	550 396	23 682	470 465
1971	13 728	503 058	23 285	450 312
1972	15 807	539 983	23 777	471 010
1973	16 803	535 151	22 076	514 340
1974	17 617	545 223	21 566	500 103

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	0.40	1.13	0	0
1965	0.39	1.12	–2.5	–0.9
1966	0.38	1.10	–5.0	–2.7
1967	0.39	1.15	–2.5	1.8
1968	0.35	1.09	–12.5	–3.5
1969	0.36	1.11	–10.0	–1.8
1970	0.49	1.17	22.5	3.5
1971	0.58	1.12	47.5	–0.9
1972	0.67	1.15	67.5	1.8
1973	0.76	1.04	90.0	–8.0
1974	0.82	1.09	105.0	–3.5

Sources: OECD, *Statistics of Energy 1959–1973*, Paris 1973, p. 151, T1, p. 168, T1; *1960–1974*, pp. 142, 148.

CHART 5

HARD COAL PRODUCTION/CONSUMPTION RATIOS

TABLE 21

1974 ANNUAL RATES OF PROFIT ON STOCKHOLDERS' EQUITY, BY INDUSTRY

(in percent)

All Manufacturing Corporations	14.9
Nondurable Manufacturing Corporations	17.2
Food and kindred products	14.0
Tobacco manufactures	15.6
Textile mill products	8.2
Paper and allied products	17.8
Printing and publishing	13.2
Chemicals and allied products	18.3
Industrial chemicals and synthetics [1]	17.5
Drugs [1]	18.8
Petroleum and coal products	21.0
Rubber and miscellaneous plastic products	14.4
Other nondurable manufacturing corporations	11.7
Durable manufacturing corporations	12.6
Stone, clay, and glass products	10.6
Primary metal industries	16.4
Iron and steel [1]	16.8
Nonferrous metals [1]	15.8
Fabricated metal products	16.6
Machinery, except electrical	13.2
Electrical and electronic equipment	11.1
Transporation equipment	8.0
Motor vehicles and equipment [1]	6.9
Aircraft, guided missiles and parts [1]	10.6
Instruments and related products	16.1
Other durable manufacturing corporations	11.7

[1] Included in major industry above.

Source: U.S. Senate, Committee on Finance, *1974 Profitability of Selected Major Oil Company Operations* (Washington: U.S. Government Printing Office, 1975), p. 31, Table 8.

TABLE 22

1974 DISTRIBUTIONS OF SELECTED METALS

	PRODUCTION*		PERCENT OF TOTAL	
	CANADA	USA	CANADA	USA
Iron	51 571.0	94 500.0	93.4	93.0
Zinc	1 278.0	500.0	2.3	0.5
Aluminum	1 125.3	4 903.0	2.0	4.8
Copper	929.0	1 597.0	1.7	1.6
Nickel	299.7	16.6	0.5	0.0
Magnesium	6.5	122.0	0.1	0.1
TOTAL	55 209.5	101 638.6	100.0	100.0

	CONSUMPTION*		PERCENT OF TOTAL	
	CANADA	USA	CANADA	USA
Iron	14 481.0	154 800.0	94.5	93.9
Zinc	121.0	1 288.0	0.8	0.8
Aluminum	427.0	6 269.0	2.8	3.8
Copper	273.0	2 194.0	1.8	1.3
Nickel	11.0	208.4	0.1	0.1
Magnesium	6.9	129.0	0.0	0.1
TOTAL	15 319.9	164 888.4	100.0	100.0

* Thousand short tons.

Sources: See tables for particular metals.

TABLE 23

SELECTED METALS*

(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	40 578.5	99 469.9	10 421.1	154 649.6
1965	42 388.8	102 714.6	10 936.5	155 034.7
1966	43 281.2	105 964.8	11 113.0	158 142.5
1967	45 262.9	99 184.7	10 074.4	150 170.8
1968	50 488.5	101 304.7	12 631.3	155 739.7
1969	43 137.9	104 908.0	11 050.8	165 473.8
1970	55 616.5	106 957.9	13 486.4	155 398.2
1971	50 745.5	96 590.0	12 811.0	138 521.8
1972	46 012.0	90 902.9	13 825.7	151 752.3
1973	55 937.2	105 066.3	15 649.9	175 508.7
1974	55 209.5	101 638.6	15 319.9	164 888.4

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	3.9	0.6	0	0
1965	3.9	0.7	0.0	16.7
1966	3.9	0.7	0.0	16.7
1967	4.5	0.7	15.4	16.7
1968	4.0	0.7	2.6	16.7
1969	3.9	0.6	0.0	0.0
1970	4.1	0.7	5.1	16.7
1971	4.0	0.7	2.6	16.7
1972	3.3	0.6	–15.4	0.0
1973	3.6	0.6	–7.7	0.0
1974	3.6	0.6	–7.7	0.0

* Iron, zinc, aluminum, copper, nickel, magnesium.

Sources: See tables for particular metals.

CHART 6

SELECTED METALS PRODUCTION/CONSUMPTION RATIOS

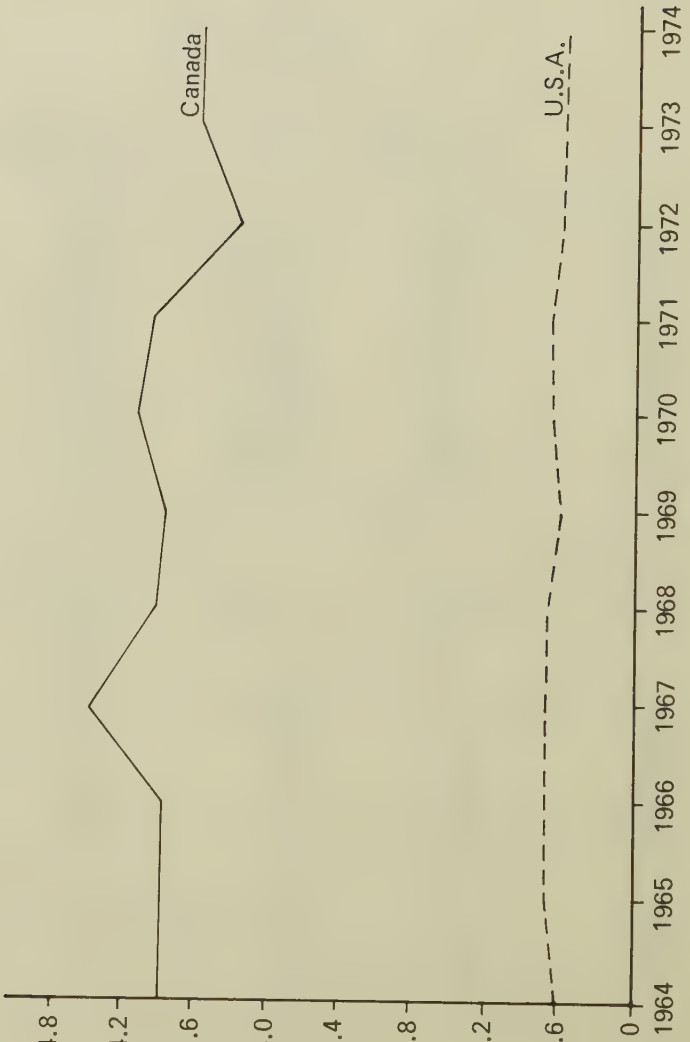


TABLE 24

IRON ORE

(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	38326	95000	9948	148200
1965	39959	97900	10391	147700
1966	40691	100900	10486	150100
1967	42318	94300	9515	142700
1968	47443	96200	12006	147600
1969	40054	98900	10419	157000
1970	52314	100600	12850	147400
1971	47352	90500	12138	130100
1972	42698	84500	13116	142100
1973	52358	98200	14880	164500
1974	51571	94500	14481	154800

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	3.85	0.64	0	0
1965	3.85	0.66	0.0	3.1
1966	3.88	0.67	0.8	4.7
1967	4.45	0.66	15.6	3.1
1968	3.95	0.65	2.6	1.6
1969	3.84	0.63	–0.3	–1.6
1970	4.07	0.68	5.7	6.3
1971	3.90	0.70	1.3	9.4
1972	3.26	0.60	–15.3	–6.3
1973	3.52	0.60	–8.6	–6.3
1974	3.56	0.61	–7.5	–4.7

Sources: U.S. Department of the Interior, Bureau of Mines, Washington. Department of Energy, Mines and Resources, Ottawa.

TABLE 25

ALUMINUM

(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	842.6	2553	172.4	3216
1965	830.5	2754	213.1	3734
1966	889.9	2968	243.3	4002
1967	963.3	3269	217.5	4009
1968	979.2	3255	242.4	4663
1969	1078.7	3793	269.0	4710
1970	1061.0	3976	275.7	4519
1971	1121.0	3925	322.1	4929
1972	1012.1	4122	333.6	5737
1973	1037.9	4529	365.7	6754
1974	1125.3	4903	427.0	6269

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	4.89	0.79	0	0
1965	3.90	0.74	–20.3	–6.3
1966	3.66	0.74	–25.2	–6.3
1967	4.43	0.82	–9.4	3.8
1968	4.04	0.70	–17.4	–11.4
1969	4.01	0.81	–18.0	2.5
1970	3.85	0.88	–21.3	11.4
1971	3.48	0.80	–28.8	1.3
1972	3.03	0.72	–38.0	–8.9
1973	2.84	0.67	–41.9	–15.2
1974	2.64	0.78	–46.0	–1.3

Sources: See Iron Ore table.

TABLE 26

COPPER

(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	487	1247	202	1825
1965	508	1352	225	2005
1966	506	1429	263	2360
1967	613	954	220	1936
1968	633	1205	250	1880
1969	573	1545	226	2142
1970	673	1720	238	2043
1971	721	1522	221	2020
1972	793	1665	229	2239
1973	908	1718	255	2437
1974	929	1597	273	2194

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2.41	0.68	0	0
1965	2.26	0.67	–6.2	–1.5
1966	1.92	0.61	–20.3	–10.3
1967	2.79	0.49	15.8	–27.9
1968	2.53	0.64	5.0	–5.9
1969	2.54	0.72	5.4	5.9
1970	2.83	0.84	17.4	23.5
1971	3.26	0.75	35.3	10.3
1972	3.46	0.74	43.6	8.8
1973	3.56	0.71	47.7	4.4
1974	3.40	0.73	41.1	7.4

Sources: See Iron Ore table.

TABLE 27

MERCURY
(pounds)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	5 548	1 074 792	208 304	6 182 904
1965	1 520	1 488 232	415 996	5 590 560
1966	NA	1 672 608	171 588	5 434 684
1967	NA	1 807 584	245 121	5 283 292
1968	430 160	2 194 424	327 939	5 732 072
1969	1 603 600	2 252 640	308 814	5 880 272
1970	1 854 400	2 074 496	340 558	4 674 228
1971	1 406 000	1 359 108	193 968	3 971 532
1972	1 112 412	558 524	114 636	4 020 932
1973	950 000	169 252	72 663	4 125 508
1974	1 064 000	166 364	83 304	4 565 320

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	0.03	0.17	0	0
1965	0.00	0.27	NA	58.8
1966	NA	0.31	NA	82.4
1967	NA	0.34	NA	100.0
1968	1.31	0.38	4 266.7	123.5
1969	5.19	0.38	17 200.0	123.5
1970	5.45	0.44	18 006.7	158.8
1971	7.25	0.34	24 066.7	100.0
1972	9.70	0.14	32 233.3	17.6
1973	13.07	0.04	43 466.7	76.5
1974	12.77	0.04	42 466.7	76.5

Sources: See Iron Ore table and Statistics Canada, *General Review of the Mineral Industries*, 1976, p. 7, T1A.

TABLE 28

NICKEL
(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	228.5	15.4	6.9	146.9
1965	259.2	16.2	8.9	172.1
1966	223.6	15.0	8.6	187.8
1967	248.7	15.3	8.8	173.8
1968	264.4	17.3	11.2	159.3
1969	213.6	17.1	12.1	141.7
1970	305.9	15.9	11.8	155.7
1971	294.3	17.0	8.6	128.8
1972	259.0	16.9	10.2	159.3
1973	274.5	18.3	11.9	197.7
1974	299.7	16.6	11.0	208.4

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	33.12	0.11	0	0
1965	29.12	0.09	–12.1	–18.2
1966	26.00	0.08	–21.5	–27.3
1967	28.26	0.09	–14.7	–18.2
1968	23.61	0.11	–28.7	0.0
1969	17.65	0.12	–46.7	9.0
1970	25.92	0.10	–21.7	–9.0
1971	34.22	0.13	3.3	18.1
1972	25.39	0.11	–23.3	0.0
1973	23.07	0.09	–30.3	–18.2
1974	27.25	0.08	–21.5	–27.3

Sources: See Iron Ore table.

TABLE 29

ZINC

(thousand short tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	685	575	88	1207
1965	822	611	94	1354
1966	964	573	107	1410
1967	1111	549	108	1237
1968	1159	529	116	1351
1969	1208	553	119	1385
1970	1252	534	106	1187
1971	1250	503	115	1254
1972	1244	478	131	1418
1973	1352	479	130	1504
1974	1278	500	121	1288

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	7.78	0.48	0	0
1965	8.75	0.45	12.5	–6.3
1966	9.01	0.41	15.8	–14.6
1967	10.29	0.44	32.3	–8.3
1968	9.99	0.39	28.4	–18.8
1969	10.15	0.40	30.5	–16.7
1970	11.81	0.45	51.8	–6.3
1971	10.87	0.40	39.7	–16.7
1972	9.50	0.34	22.1	–29.2
1973	10.40	0.32	33.7	–33.3
1974	10.56	0.39	35.7	–18.8

Sources: See Iron Ore table.

TABLE 30

MAGNESIUM

(thousand short tons, metal)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	9.4	79.5	3.8	54.7
1965	10.1	81.4	4.5	69.6
1966	6.7	79.8	5.1	82.7
1967	8.9	97.4	5.1	115.0
1968	9.9	98.4	5.7	86.4
1969	10.6	99.9	5.7	95.1
1970	10.6	112.0	4.9	93.5
1971	7.2	123.0	6.3	90.0
1972	5.9	121.0	5.9	99.0
1973	6.8	122.0	7.3	116.0
1974	6.5	122.0	6.9	129.0

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2.47	1.45	0	0
1965	2.24	1.17	–9.3	–19.3
1966	1.31	0.97	–47.0	–33.1
1967	1.75	0.85	–29.2	–41.4
1968	1.74	1.14	–29.6	–21.4
1969	1.86	1.05	–24.7	–27.6
1970	2.16	1.20	–12.6	–17.2
1971	1.14	1.37	–53.9	–5.5
1972	1.00	1.22	–59.5	–15.9
1973	0.93	1.05	–62.4	–27.6
1974	0.94	0.95	–61.9	–34.5

Sources: See Iron Ore table.

TABLE 31

MAJOR INTERNATIONAL CHEMICAL COMPANY SALES, 1973

COMPANY	TOTAL SALES (U.S. BILLIONS)
BASF (Germany)	$5.9
Hoechst (Germany)	5.7
Bayer (Germany)	5.4
Du Pont (United States)	5.3
ICI (United Kingdom)	5.2
Montedison (Italy)	4.3
UCC (United States)	3.9
Pechiney-Ugine Kuhlmann (France)	3.6
AKZO (Holland)	3.6
Dow (United States)	3.1

Source: U.S. Senate, Committee on Finance, *Hearings, Energy Conservation and Conversion Act of 1975: Part 2*, 94th Congress, 1st Session, July 1975, p. 710.

TABLE 32

TOTAL CHEMICAL TRADE

(millions of constant 1964 U.S. dollars)

	EXPORTS		IMPORTS	
	CANADA	USA	CANADA	USA
1966	393.4	2837.9	544.2	968.2
1967	396.0	2879.2	581.0	943.1
1968	413.5	3230.0	604.6	1075.1
1969	437.4	3138.4	663.1	1121.7
1970	508.6	3377.6	720.3	1263.3
1971	534.7	3414.5	791.4	1389.3
1972	548.9	3555.5	911.0	1659.1
1973	618.5	4632.3	1055.2	1877.1
1974	777.7	6434.3	1392.2	2716.7

PERCENT CHANGE OVER 1966

	EXPORTS		IMPORTS	
	CANADA	USA	CANADA	USA
1966	0	0	0	0
1967	0.7	1.5	6.8	−2.6
1968	5.1	13.8	11.1	11.0
1969	11.2	10.6	21.9	15.9
1970	29.3	19.0	32.4	30.5
1971	35.9	20.3	45.4	43.5
1972	39.5	25.3	67.4	71.4
1973	57.2	63.2	93.9	93.9
1974	96.7	126.7	155.8	180.6

Source: Calculated from Table 33.

TABLE 33

TOTAL CHEMICAL TRADE*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	417.2	3 009.7	577.1	1026.8	0.72	2.93	0	0
1967	433.6	3 152.5	636.1	1032.6	0.68	3.05	–5.6	4.1
1968	470.8	3 677.6	688.4	1224.2	0.68	3.00	–5.6	2.4
1969	522.1	3 746.0	791.5	1338.8	0.66	2.80	–8.3	–4.4
1970	640.2	4 251.8	906.7	1590.2	0.71	2.67	–1.4	–8.9
1971	705.0	4 501.6	1043.4	1831.7	0.68	2.46	–5.6	–16.0
1972	746.7	4 836.7	1239.3	2257.0	0.60	2.14	–16.7	–27.0
1973	886.2	6 637.5	1511.9	2689.6	0.59	2.47	–18.1	–15.7
1974	1232.5	10 197.0	2206.4	4305.4	0.56	2.37	–22.2	–19.1

* Includes the trade for the chemical products in our specific tables, plus all other categories of chemical products.

Sources: See Organic Chemicals table.

CHART 7

TOTAL CHEMICAL TRADE EXPORT/IMPORT RATIOS

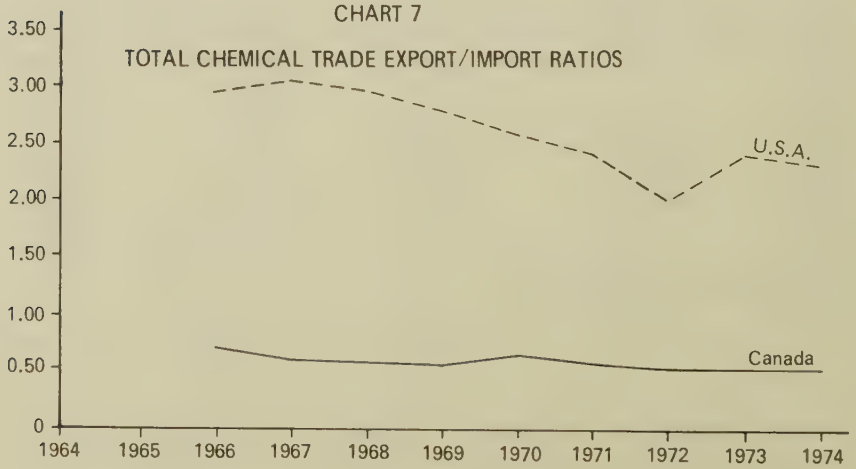


TABLE 34

1974 DISTRIBUTIONS OF CHEMICAL IMPORTS AND EXPORTS
(millions of current US dollars)

	EXPORTS		PERCENT OF TOTAL	
CHEMICAL GROUP*	CANADA	USA	CANADA	USA
Fertilizers	431.0	811.6	35.0	8.0
Inorganic chemicals	182.8	507.8	14.8	5.0
Organic chemicals	130.1	2 568.1	10.6	25.2
Insecticides	62.9	1 166.3	5.1	11.4
Plastics	57.7	1 617.6	4.7	15.9
Medicines	54.6	800.1	4.4	7.9
Paints	15.2	181.8	1.2	1.8
Explosives	5.5	49.8	0.5	0.5
Perfumes	5.4	85.1	0.4	0.8
Soaps	1.7	175.3	0.1	1.7
Others	285.9	2 223.0	23.2	21.8
Total	1232.5	10 197.0	100.0	100.0

	IMPORTS		PERCENT OF TOTAL	
	CANADA	USA	CANADA	USA
Plastics	537.6	331.3	24.4	7.7
Organic chemicals	371.1	1387.9	16.8	32.2
Insecticides	321.7	256.4	14.6	6.0
Medicines	162.3	213.6	7.4	5.0
Inorganic chemicals	71.3	605.7	3.2	14.1
Paints	67.3	25.3	3.1	0.6
Soaps	47.9	29.4	2.2	0.7
Fertilizers	32.0	559.9	1.5	13.0
Perfumes	23.0	37.3	1.0	0.9
Explosives	11.0	19.6	0.5	0.5
Others	313.3	830.9	14.2	19.3
Total	2206.4	4305.4	100.0	100.0

* For a more complete description of each group of chemicals, see specific tables.

Sources: See tables for specific chemicals and total chemical trade.

TABLE 35
INSECTICIDES, FUNGICIDES AND DISINFECTANTS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	30.1	393.5	80.4	65.8	0.37	5.98	0	0
1967	31.0	415.9	92.5	67.4	0.34	6.17	–8.1	3.2
1968	36.1	504.1	100.8	71.1	0.36	7.09	–2.7	18.6
1969	45.7	466.6	120.2	68.0	0.38	6.86	2.7	14.7
1970	39.1	551.7	111.3	85.4	0.35	6.46	–5.4	8.0
1971	39.4	574.2	142.4	95.5	0.28	6.01	–24.3	0.5
1972	40.9	556.4	179.2	139.6	0.23	3.99	–37.8	–33.3
1973	48.0	767.3	229.2	172.3	0.21	4.45	–43.2	–25.6
1974	62.9	1166.3	321.7	256.4	0.20	4.55	–46.0	–23.9

* Includes similar preparations and starches, inulin, gluten, glues, wood and resin-based chemical products.

Sources: See Organic Chemicals table.

TABLE 36
FERTILIZERS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	129.0	220.7	14.8	130.8	8.72	1.69	0	0
1967	143.0	230.6	13.5	142.3	10.59	1.62	21.5	–4.1
1968	156.2	267.6	11.3	142.4	13.82	1.88	58.5	11.2
1969	159.0	218.1	10.3	137.4	15.44	1.59	77.1	–5.9
1970	217.0	177.7	13.2	192.2	16.44	0.93	88.5	–45.0
1971	236.2	191.1	15.8	205.3	14.95	0.93	71.5	–45.0
1972	251.8	298.4	16.8	231.9	14.99	1.29	71.9	–23.7
1973	282.8	406.5	18.4	279.9	15.37	1.45	76.3	–14.2
1974	431.0	811.6	32.0	559.9	13.47	1.45	54.5	–14.2

* Manufactured nitrogenous, phosphatic and potassic fertilizers.

Sources: See Organic Chemicals table.

TABLE 37

ORGANIC CHEMICALS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	53.1	690.5	101.5	227.1	0.53	3.04	0	0
1967	62.0	748.5	110.4	218.6	0.56	3.42	5.7	12.5
1968	63.1	849.6	122.8	281.2	0.51	3.02	–3.8	–0.7
1969	61.8	905.0	133.2	314.4	0.46	2.88	–13.2	–5.3
1970	67.3	1069.6	133.3	355.2	0.51	3.01	–3.8	–1.0
1971	58.2	988.8	138.8	400.0	0.42	2.47	–20.8	–18.8
1972	54.1	1102.7	173.0	509.0	0.31	2.17	–41.5	–28.6
1973	68.9	1509.8	216.1	624.1	0.32	2.42	–39.6	–20.4
1974	130.1	2568.1	371.1	1387.9	0.35	1.85	–34.0	–39.1

* For example, hydrocarbons, alcohols, phenols, ethers, epoxides, aldehyde, acids, nitrogen-function compounds, and other organic chemicals.

Sources: OECD, *The Chemical Industry, 1966–1967*, pp. 142–143, T3, 4; *1967–1968*, pp. 152–153, T3, 4; *1968–1969*, pp. 146–147, T3, 4; *1969–1970*, p. 54, T8, p. 55, T9; *1970–1971*, p. 58, T8, p. 59, T9; *1971–1972*, p. 60, T8, p. 61, T9; *1972–1973*, p. 58, T9, p. 59, T8; *1973–1974*, p. 48, T8, p. 49, T9; *1974–1975*, p. 45, T8, p. 46, T9.

TABLE 38

INORGANIC CHEMICALS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	45.8	171.7	30.5	152.4	1.50	1.13	0	0
1967	47.9	191.2	31.0	167.0	1.55	1.15	3.3	1.8
1968	53.7	231.6	32.8	201.6	1.64	1.15	9.3	1.8
1969	78.4	245.5	36.1	245.2	2.17	1.00	44.7	–11.5
1970	109.4	286.7	36.6	307.5	2.99	0.93	99.3	–17.7
1971	103.1	272.6	35.9	285.7	2.87	0.95	91.3	–15.9
1972	114.7	262.1	39.1	348.2	2.93	0.75	95.3	–33.6
1973	146.7	337.9	48.6	429.0	3.02	0.79	101.3	–30.1
1974	182.8	507.8	71.3	605.7	2.56	0.84	70.7	–25.7

* For example, oxygen, nitrogen, hydrogen, rare gases, chemical elements, inorganic acids, halogen and sulphur compounds, metallic oxides, metallic salts and inorganic chemical products.

Sources: See Organic Chemicals table.

TABLE 39

MEDICINAL AND PHARMACEUTICAL PRODUCTS*

(millions of current US dollars)

	EXPORTS		IMPORTS		RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	17.7	269.0	45.3	74.8	0.39	3.60	0	0
1967	19.6	288.0	53.3	71.7	0.37	4.02	–5.1	11.7
1968	18.9	313.7	55.4	75.8	0.34	4.14	–12.8	15.0
1969	27.5	363.3	68.9	83.2	0.40	4.37	2.6	21.4
1970	34.4	420.3	105.0	87.3	0.33	4.81	–15.4	33.6
1971	34.2	395.8	86.7	119.4	0.40	3.32	2.6	–7.8
1972	40.9	473.5	102.3	149.0	0.40	3.18	2.6	–11.7
1973	48.4	626.0	119.0	163.4	0.41	3.83	5.1	6.4
1974	54.6	800.1	162.3	213.6	0.34	3.75	–12.8	4.2

* For example, vitamins, penicillin, streptomycin, antibiotics, opium alkaloids, cocaine, caffein, quinine, hormones, glycosides, sera, vaccines, medicaments and other pharmaceutical goods.

Sources: See Organic Chemicals table.

TABLE 40

PERFUMERY AND COSMETICS*

(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO% CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	1.2	26.4	5.7	13.0	0.21	2.03	0	0
1967	1.4	26.5	7.5	12.7	0.19	2.09	–9.5	3.0
1968	1.3	31.1	8.6	13.8	0.15	2.25	–28.6	10.8
1969	1.4	32.4	9.2	16.7	0.15	1.94	–28.6	–4.4
1970	1.8	34.5	9.9	18.5	0.18	1.87	–14.3	–7.9
1971	2.5	34.0	10.0	21.1	0.25	1.61	19.1	–20.7
1972	2.5	41.9	13.9	27.0	0.18	1.55	–14.3	–23.7
1973	2.4	57.4	16.9	27.9	0.14	2.06	–33.3	1.5
1974	5.4	85.1	23.0	37.3	0.25	2.28	19.1	12.3

* Including dentifrices and other toilet preparations except soaps.

Sources: See Organic Chemicals table.

TABLE 41

SOAPS, CLEANSING AND POLISHING PREPARATIONS*

(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO% CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	0.7	66.4	13.1	6.0	0.05	11.07	0	0
1967	0.8	69.8	14.7	6.9	0.05	10.12	0.0	–8.6
1968	0.6	81.5	17.0	7.9	0.04	10.32	–20.0	–6.8
1969	0.6	79.5	19.5	10.0	0.03	7.95	–40.0	–28.2
1970	1.0	85.6	20.5	10.0	0.05	8.56	0.0	–22.7
1971	0.9	87.8	24.9	11.9	0.04	7.38	–20.0	–33.3
1972	1.3	93.4	29.4	14.1	0.04	6.62	–20.0	–40.2
1973	1.6	122.3	36.0	18.6	0.04	6.58	–20.0	–40.6
1974	1.7	175.3	47.9	29.4	0.04	5.96	–20.0	–46.2

* Including surface-acting agents, pastes, powder and other preparations for polishing leather, wood, metal, glass and other materials.

Sources: See Organic Chemicals table.

TABLE 42
EXPLOSIVES AND PYROTECHING PRODUCTS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO% CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	3.6	21.8	2.9	20.6	1.24	1.06	0	0
1967	4.2	18.5	3.0	41.0	1.40	0.45	12.9	–57.5
1968	4.8	20.4	3.8	40.5	1.26	0.50	1.6	–52.8
1969	3.8	17.7	4.6	35.2	0.83	0.50	–33.1	–52.8
1970	3.8	20.3	4.7	28.0	0.81	0.73	–34.7	–31.1
1971	3.9	22.3	5.4	25.0	0.72	0.89	–41.9	–16.0
1972	4.1	28.0	7.0	21.1	0.59	1.33	–52.4	25.5
1973	4.5	30.8	6.9	26.7	0.65	1.15	–47.6	8.5
1974	5.5	49.8	11.0	19.6	0.50	2.54	–59.7	139.6

* Including propellent powders, fuses, primers, detonators, hunting and sporting ammunition.

Sources: See Organic Chemicals table.

TABLE 43
PIGMENTS, PAINTS, VARNISHES*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO% CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	3.4	68.3	30.5	5.2	0.11	13.14	0	0
1967	3.6	74.3	35.3	5.7	0.10	13.04	–9.1	–0.8
1968	4.5	85.7	36.7	7.9	0.12	10.85	9.1	–17.4
1969	5.1	84.8	42.1	8.9	0.12	9.53	9.1	–27.5
1970	4.1	90.7	40.2	8.7	0.10	10.43	–9.1	–20.6
1971	4.9	91.5	34.8	10.1	0.14	9.06	27.3	–31.1
1972	7.4	100.0	40.9	15.9	0.18	6.29	63.6	–52.2
1973	11.4	126.1	51.2	20.9	0.22	6.03	100.0	–54.1
1974	15.2	181.8	67.3	25.3	0.23	7.18	109.1	–45.4

* For example, colouring materials, printing inks, prepared paints, enamels, lacquers, varnishes, paint driers and mastics.

Sources: See Organic Chemicals table.

TABLE 44

PLASTIC MATERIALS*
(millions of current US dollars)

	EXPORTS		IMPORTS		EXPORT/IMPORT RATIO		RATIO % CHANGE OVER 1966	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1966	20.8	472.5	119.9	60.1	0.17	7.86	0	0
1967	21.4	473.3	133.0	60.3	0.16	7.85	–5.9	–0.1
1968	24.6	590.0	154.5	94.1	0.16	6.27	–5.9	–20.2
1969	27.8	589.7	173.7	99.0	0.16	5.96	–5.9	–24.2
1970	31.1	652.8	175.7	122.8	0.18	5.32	5.9	–32.3
1971	30.1	656.8	213.2	132.5	0.14	4.96	11.7	–36.9
1972	41.2	696.3	263.5	176.6	0.16	3.94	–5.9	–49.9
1973	53.5	1027.9	322.0	206.5	0.17	4.98	0.0	–36.6
1974	57.7	1617.6	537.6	331.3	0.11	4.88	–35.3	–37.9

* Including regenerated cellulose, artificial resins, polyethylene, polystyrene, polyvinyl and vulcanized fibre.

Sources: See Organic Chemicals table.

TABLE 45

FIVE-FIRM CONCENTRATION RATIOS IN CANADIAN FORESTRY PRODUCTS 1964–1974

PRODUCT*	FIVE-TERM RATIO (PERCENT) 1964	1974
Lumber	21	23
Newsprint	54	62
Pulp for sale	44	30
Paperboard	67	60
Printing and writing paper	80	79

* The same five firms do not dominate each product line.

Source: Forest Products Group, Resource Industries Branch, Department of Industry, Trade and Commerce, *Review of the Canadian Forest Products Industry* (Ottawa: Ministry of Supply and Services Canada, 1979), p. 138, Table 57.

TABLE 46

LUMBER: HARDWOOD AND SOFTWOOD
(billion board feet)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	10.4	36.6	4.2	41.4
1965	10.8	36.8	4.6	40.8
1966	10.6	36.6	4.7	41.0
1967	10.3	35.6	4.2	39.5
1968	11.4	36.5	4.5	41.9
1969	11.5	35.8	5.0	40.5
1970	11.3	34.7	4.1	38.1
1971	12.7	37.0	4.5	44.3
1972	14.0	37.7	4.6	46.7
1973	15.5	38.6	6.0	45.6
1974	13.6	34.6	5.8	38.9

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2.5	0.88	0	0
1965	2.4	0.90	–4.0	2.3
1966	2.3	0.89	–8.0	1.1
1967	2.5	0.90	0.0	2.3
1968	2.5	0.87	0.0	–1.1
1969	2.3	0.88	–8.0	0.0
1970	2.8	0.91	12.0	3.4
1971	2.8	0.84	12.0	–4.6
1972	3.0	0.81	20.0	–8.0
1973	2.6	0.85	4.0	–3.4
1974	2.4	0.89	–4.0	1.1

Sources: Forest Products Group, Resource Industries Branch, Department of Industry, Trade and Commerce, Ottawa, Ontario.
Statistical Abstract of the United States 1967, p. 663, T982; *1969*, p. 641, T977; *1971*, p. 616, T1006; *1974*, p. 643, T1092; *1978*, p. 736, T1271; *1979*, p. 731, T1277.

CHART 8

LUMBER PRODUCTION/CONSUMPTION RATIOS

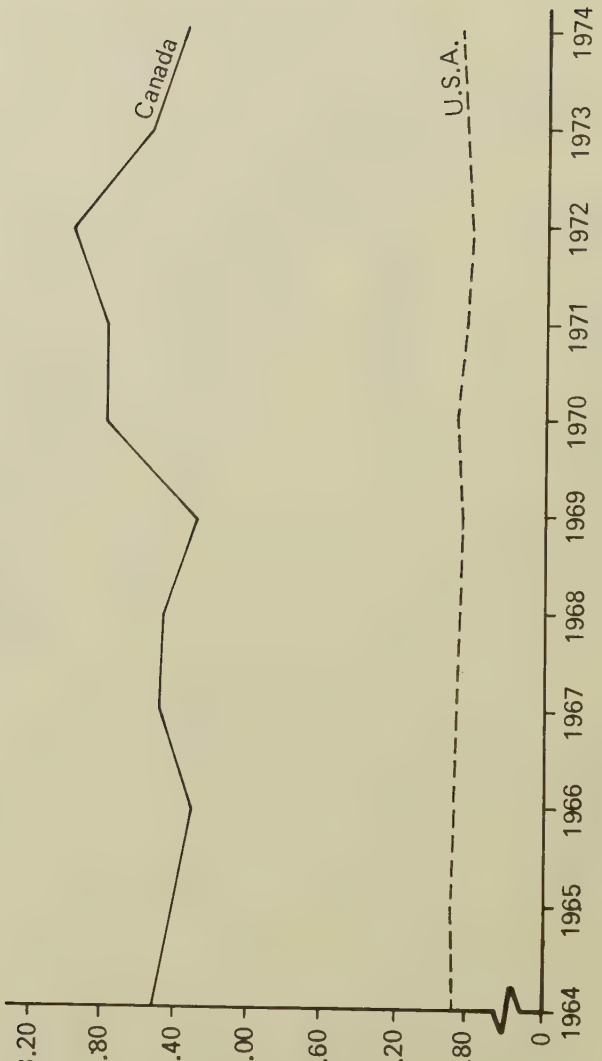


TABLE 47

FOREST FIRES

	TOTAL NUMBER		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	6944	114 544	0	0
1965	7238	111 694	4.2	−2.4
1966	7468	119 294	7.5	4.1
1967	8650	122 518	24.5	6.9
1968	7301	122 462	5.1	6.9
1969	6633	110 648	−4.4	−3.4
1970	9253	118 154	33.2	3.1
1971	9173	104 464	32.0	−8.8
1972	8227	119 801	18.4	4.5
1973	7567	114 759	8.9	0.2
1974	8100	141 463	16.6	23.5

Sources: Dominion Fire Commissioner, *Fire Losses in Canada 1969*, p. 8, T1b; *Canada Year Book 1973*, p. 450, T10.3; *1974*, p. 405, T10.3.
U.S. Department of Agriculture, *Agricultural Statistics 1973*, p. 554, T774; *1978*, p. 543, T751.
Forest Fire Research Institute, Environment Canada.

TABLE 48

AREA BURNED IN FOREST FIRES

	TOTAL AREA (1000 ACRES)		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2993	4142	0	0
1965	521	2570	–82.5	–37.9
1966	1144	3612	–61.7	–12.7
1967	2212	4467	–26.0	7.8
1968	2212	3185	–26.0	–23.1
1969	2331	2652	–22.1	–35.9
1970	2616	3006	–12.5	–27.4
1971	4188	2677	39.9	–35.3
1972	1927	1504	–35.6	–63.6
1973	2926	1373	–2.2	–66.9
1974	2908	1817	–2.8	–56.1

Sources: *Canada Year Book 1967*, p. 515, T5; *1968*, p. 544, T6; *1969*, p. 534, T6; *1970–71*, p. 617, T5; *1973*, p. 450, T10.3; *1974* p. 404, T10.3.
U.S. Department of Agriculture, *Agricultural Statistics 1973*, p. 554, T774; *1978*, p. 543, T751.
Forest Fire Research Institute, Environment Canada.

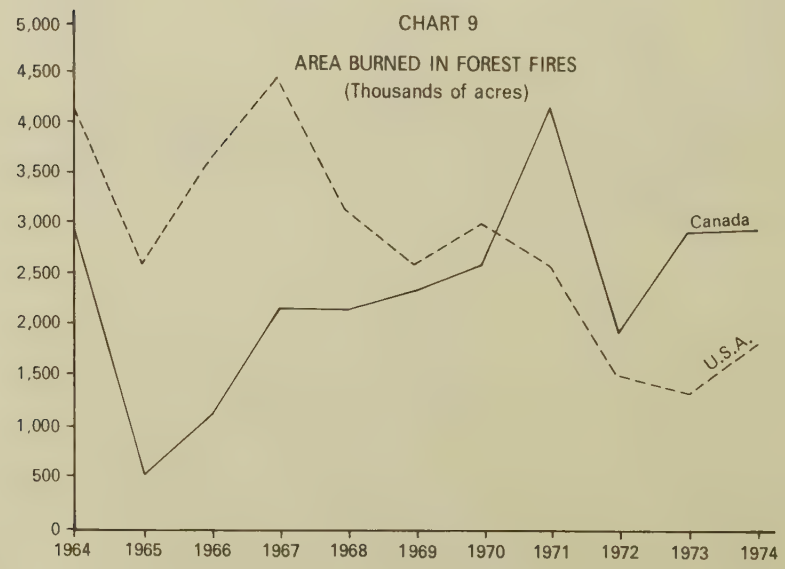


TABLE 49

DISTRIBUTION OF LAND TYPES, 1975

TYPE	CANADA		USA	
	SQUARE KILOMETERS[a]	PERCENT	SQUARE KILOMETERS	PERCENT
Arable and crop land[b]	392 610	3.9	1 910 000	20.4
Permanent grassland	243 000	2.4	2 440 000	26.1
Wooded area	4 430 940	44.4	2 888 450	30.9
Other areas[c]	4 909 590	49.3	2 125 000	22.6
Total	9 976 140	100.0	9 363 450	100.0

[a] One square kilometer equals 0.3861 square miles.

[b] This is the sum of arable area and of land under permanent crop.

[c] This includes built up land, desert, tundras, muskeg, ice, dunes, mountains, inland waters.

Source: Organization for Economic Co-operation and Development, *The State of the Environment in OECD Countries*, Paris, 1979, p. 165, Annex 20.

TABLE 50

WEIGHT OF EMISSIONS OF AIR POLLUTANTS

(thousands of tons per year)

	SOx		CO		PARTICULATES		HC		NOx	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1968	NA	31 000	NA	150 000	NA	26 000	NA	35 000	NA	21 000
1969	NA	34 000	NA	154 000	NA	27 000	NA	35 000	NA	22 000
1970	7209	34 000	17 312	147 000	2290	25 000	3072	35 000	1359	23 000
1971*	NA	30 755	NA	110 452	NA	23 589	NA	32 298	NA	23 479
1972	6650	31 747	15 060	112 436	2240	22 377	2570	32 739	1915	24 471
1973	NA	32 738	NA	108 357	NA	21 936	NA	32 849	NA	25 243
1974	6174	31 085	15 336	100 861	2385	19 290	2499	31 526	2082	24 912

TABLE 50 (continued)

RATE PER 100 000 INHABITANTS (tons)

	SOx		CO		PARTICULATES		HC		NOx	
	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA	CANADA	USA
1968	NA	15 446	NA	74 738	NA	12 955	NA	17 439	NA	10 463
1969	NA	16 774	NA	75 974	NA	13 321	NA	17 267	NA	10 854
1970	33 845	16 594	81 277	71 742	10 751	12 201	14 423	17 082	6380	11 225
1971	NA	14 857	NA	53 358	NA	11 393	NA	15 600	NA	11 340
1972	30 463	15 201	68 988	53 848	10 261	19 715	11 773	15 677	8772	11 718
1973	NA	15 582	NA	51 500	NA	10 426	NA	15 613	NA	11 998
1974	27 506	14 670	68 324	47 598	10 626	9 103	11 133	14 878	9276	11 756

* US figures in 1971 begin a new series which is not strictly comparable to earlier years.

Sources: U.S. Council on Environmental Quality, *Third Annual Report*, 1972, p. 6, T2.
Environment Canada, *A Nationwide Inventory of Air Pollutant Emissions: Summary of Emissions for 1970*, p. 2, T1a.
Pollution Data Analysis Division, Air Pollution Control Directorate, Environment Canada.
U.S. Council on Environmental Quality, *Environmental Statistics 1978*, p. 248, T12–7, p. 250, T12–8, p. 251, T12–9, p. 252, T12–10, p. 265, T12–11.
Environment Canada, *A Nationwide Inventory of Emissions of Air Contaminants* (1974), p. iii, T1.

TABLE 51

TOXIC RESIDUES IN GREAT LAKES FISH, 1969–1976

(in parts per million)

YEAR	DDT		
	LAKE TROUT	COHO SALMON	BLOATERS
1969	(a)	11.82	9.94
1970	19.19	14.03	9.87
1971	13.00	9.85	6.24
1972	11.31	7.17	4.33
1973	9.96	4.48	2.09
1974	8.42	3.82	1.33
1975	7.50	3.25	1.27
1976	5.65	2.98	0.90(b)

YEAR	DIELDRIN		
	LAKE TROUT	COHO SALMON	BLOATERS
1969	(a)	0.21	0.27
1970	0.27	0.12	0.19
1971	0.20	0.11	0.27
1972	0.20	0.13	0.18
1973	0.27	0.09	0.28
1974	0.30	0.10	0.28
1975	0.35	0.10	0.39
1976	0.30	0.08	0.35

YEAR	PCB'S		
	LAKE TROUT	COHO SALMON	BLOATERS
1969	(a)	(a)	(a)
1970	(a)	(a)	(a)
1971	(a)	(a)	(a)
1972	12.86	10.93	5.66
1973	18.93	12.17	5.24
1974	22.91	10.45	5.57
1975	22.28	10.77	4.54
1976	18.68	9.21	4.11

TABLE 51 (continued)

YEAR	MERCURY			
	WALLEYE (1)	ROCK BASS (1)	CHANNEL CATFISH	YELLOW PERCH (1)
1969	(a)	(a)	(a)	(a)
1970	2.83	(a)	(a)	(a)
1971	(a)	(a)	(a)	(a)
1972	1.38	(a)	(a)	(a)
1973	1.18	1.24	1.62(1)	(a)
1974	1.07	0.49	0.37	1.22
1975	1.03	0.37	0.35	0.31
1976	0.78	0.37	0.35	0.28

Concentrations of DDT, Dieldrin and PCB's are from fall collections of Lake Michigan bloaters and lake trout off Saugatuck, Michigan, and coho salmon from east-central Lake Michigan. Mercury concentrations are from fall collections of selected Lake St. Clair fish. Concentrations are in whole fish (except where noted) and are wet weight.

Food and Drug Administration maximum allowable levels of toxic substances in fish are: DDT—5.0 ppm; PCB's—5.0 ppm; Dieldrin—0.3 ppm; and Mercury—0.5 ppm. (The level for PCB's is under review for a change to 2.0 ppm.) However, these FDA guidelines are not strictly comparable to data here since the guidelines pertain only to edible portions of the fish, and the Fish and Wildlife Service monitoring program generally analyzes the whole body of the fish. Concentrations of toxics in edible portions of fish are slightly lower than those in whole fish.

(1) Concentrations in fillets, not whole fish.

(a) Not measured.

(b) Also includes DDE, a derivative of DDT.

Source: Council on Environmental Quality, *Environmental Statistics 1978* (Springfield, Virginia: National Technical Information Service, U.S. Department of Commerce, 1979), p. 181, Table 8—11.

TABLE 52

CANADIAN ENDANGERED, THREATENED, RARE AND EXTIRPATED SPECIES, 1978 AND 1979

SPECIES	STATUS
1978	
Trumpeter Swam	RARE
Caspian Tern	RARE
Peregrine Falcon — subspecies *pealei*	RARE
Black-tailed Prairie Dog	RARE
White Pelican	THREATENED
Peregrine Falcon — subspecies *tundrius*	THREATENED
Piping Plover	THREATENED
Peregrine Falcon — subspecies *anatum*	ENDANGERED
Greater Prairie Chicken	ENDANGERED
Whooping Crane	ENDANGERED
Eskimo Curlew	ENDANGERED
Vancouver Island Marmot	ENDANGERED
Sea Otter	ENDANGERED
Eastern Cougar	ENDANGERED
Wood Bison	ENDANGERED
Swift Fox	EXTIRPATED
Black-footed Ferret	EXTIRPATED
Gyrfalcon	not in any category
Double-crested Cormorant	not in any category
1979	
Ipswich Sparrow	RARE
Great Gray Owl	RARE
Ivory Gull	RARE
Burrowing Owl	THREATENED
Kirtland's Warbler	ENDANGERED
Greater Sandhill Crane	not in any category
Pocket Gopher	RARE
Grey Fox	RARE
Peary Caribou	THREATENED
Grissly Bear	not in any category
Fox Squirrel	not in any category
Newfoundland Marten	not in any category
Badger	not in any category

Source: Committee on the Status of Endangered Wildlife in Canada (COSEWIC), *Status Reports and Evaluations*, Volume 1, April 1978; Volume 2, April 1979.

TABLE 53

THREATENED AND ENDANGERED SPECIES IN THE UNITED STATES, 1978

	NUMBER OF ENDANGERED SPECIES (1)			NUMBER OF THREATENED SPECIES (2)		
CATEGORY	U.S. (3)	FOREIGN (4)	TOTAL	U.S. (3)	FOREIGN (4)	TOTAL
Mammals	33	227	260	3	18	21
Birds	67	144	211	3		3
Reptiles	11	47	58	10		10
Amphibians	5	9	14	2		2
Fishes	29	10	39	12		12
Snails	2	1	3	5		5
Clams	23	2	25			
Crustaceans	1		1			
Insects	6		6	2		2
Plants	20		20	2		2
Total	197	440	637	39	18	57

Data as of November 30, 1978.

(1) An endangered species is one that is in danger of becoming extinct throughout all or a significant part of its natural range.

(2) A threatened species is one that is likely to become endangered in the forseeable future.

(3) Includes 50 states and all U.S. territories.

(4) Foreign species are those living outside the U.S. and its territories. Their number, as determined by the U.S. Department of the Interior, Fish and Wildlife Service, includes those listed by the International Trade Convention in Endangered Species, the International Union for Conservation of Nature and Natural Resources, and those species that are generally accepted in the biological community as being endangered or threatened.

Source: Council on Environmental Quality, *Environmental Statistics 1978* (Springfield, Virginia: National Technical Information Service, U.S. Department of Commerce, 1979), p. 171, Table 8–5.

TABLE 54

POPULATION OF SELECTED ENDANGERED, THREATENED, AND OTHER IMPORTANT SPECIES, UNITED STATES, 1900–1977

SPECIES	POPULATION	YEAR
California Brown Pelican (1)	100 000	1972
American Alligator (2)	52 165	1970
Eastern Brown Pelican (3)	17 000	1972
Red Cockaded Woodpecker	3000–10 000	1972
Utah Prairie Dog	5715	1972
Southern Bald Eagle (4)	2000–4000	1971
Arctic Peregrine Falcon (5)	3000	1972
San Joaquin Kit Fox	1000–3000	1972
Attwater's Greater Prairie Chicken	2200	1971
Eastern Timber Wolf (6)	832–1332	1970
Grizzly Bear	695–1020	1970
Key Deer	30	1949
	300	1964
	600	1972
Delmarva Peninsula (Bryant) Fox Squirrel	468	1872
Red Wolf (7)	16	1968
Whooping Crane (8)	1000–2000	Presettlement
	14	1939
	80	1972
	126	1976
American Peregrine Falcon (9)	59–61	1970
California Condor	800	Pre-1900
	100	1948
	65	1965
	55	1970
	45	1977
Black Footed Ferret (10)	31–32	1972

(1) Includes those in California and Mexico.
(2) Excludes several thousand in captivity.
(3) Estimated 8500 breeding pairs.
(4) Includes the 48 conterminous states.
(5) Estimated from a few thousand breeding pairs.
(6) Excludes 22 in captivity.
(7) Includes only those in captivity.
(8) Estimate includes those wild and in captivity.
(9) Includes those in captivity but excludes a few thousand pairs in the interior of Alaska.
(10) Excludes 3 in captivity.

Source: Council on Environmental Quality, *Environmental Statistics 1978* (Springfield, Virginia: National Technical Information Service, U.S. Department of Commerce, 1979), pp. 172–173, Table 8–6.

TABLE 55
CONTINENTAL WATERFOWL POPULATION LEVELS
(in millions)

SPECIES	POPULATION COMPONENT MEASURED	RECENT POPULATION RANGE (1)	1978 POPULATION LEVEL	POPULATION TREND (1, 2)
Ducks				
Mallard	Breeding	5.9–12.9	7.6	V–D
Gadwall	Breeding	0.7–2.1	2.0	S
Wigeon	Breeding	2.2–3.8	3.8	S
Green-winged Teal	Breeding	1.1–3.2	3.0	S
Blue-winged Teal	Breeding	3.7–6.4	4.5	S
Shoveler	Breeding	1.4–2.5	2.2	S
Pintail	Breeding	4.1–10.5	5.7	V–D
Redhead	Breeding	0.4–1.0	0.8	V–S
Canvasback	Breeding	0.4–0.7	0.4	V–S
Scaup	Breeding	5.4–9.5	7.1	I
Canada Geese:				
Atlantic Flyway	Post-Season	0.68–0.92	0.80	I
Mississippi Flyway	Post-Season	0.50–1.07	1.09	I
Central Flyway	Post-SEason	0.16–0.59	0.58	V–I
Pacific Flyway	Post-Season	0.20–0.49	0.43	V–I
Snow Geese:				
Atlantic Flyway	Post-Season	0.03–0.13	0.10	I
Mississippi Flyway	Post-Season	0.28–0.94	0.80	S
Central Flyway	Post-Season	0.36–1.21	1.20	I
Pacific Flyway	Post-Season	0.24–0.51	0.24	S
Ross' Geese	Post-Season	0.02–0.04	0.03	S
White-fronted Geese:				
Central Flyway	Spring	0.08–0.34	0.34	I
Pacific Flyway	Post-Season	0.05–0.20	0.11	V–D
Brant				
Atlantic Flyway	Post-Season	0.04–0.15	0.05	D
Pacific Flyway	Post-Season	0.12–0.16	0.16	V–D
Whistling Swan:				
Atlantic Flyway	Post-Season	0.06–0.08	0.07	I
Pacific Flyway	Post-Season	0.03–0.08	0.05	S

(1) Generally for period 1955–77, except 1969–1978 for geese. Breeding population estimates based on May breeding ground surveys. Most estimates include adjustment for unseen birds and, therefore, represent actual numbers of birds.
(2) I, Increase; D, Decrease; S, Stable; V, Variable/fluctuating.

Source: Council on Environmental Quality, *Environmental Statistics 1978* (Springfield, Virginia: National Technical Information Service, U.S. Department of Commerce, 1979), p. 169, Table 8–3.

TABLE 56

PELTS OF WILDLIFE AND FARM FUR-BEARING ANIMALS TAKEN IN CANADA, BY KIND, 1974–75 FUR SEASON

WILDLIFE PELTS		NUMBER	VALUE (CURRENT DOLLARS)
Badger		3 626	56 990
Bear			
White		548	347 706
Black or brown		3 585	114 635
Grizzly		20	5 249
Beaver		357 732	5 990 920
Cougar		33	3 404
Coyote		44 366	1 416 512
Ermine (weasel)		88 098	81 011
Fisher		10 163	463 739
Fox			
Blue		207	4 226
Cross and red		43 103	1 450 227
Silver		429	13 827
White		31 913	593 249
Not specified		13 563	429 575
Lynx		20 648	2 331 933
Marten		47 598	538 250
Mink		63 083	688 792
Muskrat		1 762 589	4 519 164
Otter		15 258	629 655
Rabbit		8 353	3 595
Raccoon		81 504	1 015 354
Seals			
Fur, North Pacific		7 543	344 312
Hair		157 472	3 074 246
Shunk		596	862
Squirrel		469 093	336 755
Wildcat		3 425	133 235
Wolf		5 510	246 957
Wolverine		1 090	115 328
	Sub total	3 241 148	24 949 708
Farm Pelts		1 114 609	16 591 658
	Total	4 355 757	41 541 366

Source: Statistics Canada, *Canada Year Book 1976–77* (Ottawa: Supply and Services Canada, 1977), p. 506, Tables 10.20 and 10.21.

CHAPTER 10

TRANSPORTATION AND COMMUNICATION

> "The use of travelling is to regulate imagination by reality, and, instead of thinking how things may be, to see them as they are."
>
> Samuel Johnson

1. INTRODUCTION

When I first noticed a chapter in a copy of the *Statistical Abstract of the United States* called 'Transportation and Communication', I thought that it was a strange pair of topics to combine. The more I thought about it, however, the more sensible it became. There's a sense in which transportation is a kind of communication and vice versa. Transportation implies movement of some sort, the movement of something to something else. But without some type of movement there can be no communication. Sounds, signs or signals are the vehicles of communication, and they must be exchanged if there is to be any communication at all. Going in the opposite direction, without some kind of communication, there can be no transportation. But the sense of the term 'communication' involved in this case is different from that requiring signals. The communication that's necessary for transportation is simply a kind of interaction of transported and transporting entities from some place or state to some other. What made the idea of action at a distance incomprehensible to physicists from Democritus to Newton and Maxwell was precisely that it seemed to involve movement without anything touching (physically communicating with) anything else.[1]

The structure of the chapter is as follows. In the next section some observations are made on the significance of transportation for life generally and human life in particular. Following that there are six sections, dealing first with motor vehicles (Section 3), then passenger cars (4), transportation deaths and injuries (5), railroads (6), comparisons of different types of vehicles (7) and international travel (8). Given the dominance of passenger cars in North America and the difficulties encountered in attempting to get comparable time series for all modes of transportation, I decided to give the most space to information concerning cars. Sections 9 to 11 are about three means of

communication, namely, telephones (9), mail (10) and newspapers (11). Section 12 briefly reviews the dollar costs to individuals for transportation and communication in North America. That's followed by a summary of the chapter and its contribution to our total story.

2. BEING AND MOVING

The most famous fragment of the philosophy of Heraclitus of Ephesus (c. 500 B.C.) says simply "Everything flows." The very essence of existence, he thought, was movement, not only or always change of place, but of state or way of being.[2] Although the entire metaphysical system of which this fragment was a part was a bit fanciful (even by the standards of ancient Greece), the idea that the natural state of all things might be forever changing instead of unchanging was profound. Indeed, the fundamental difference between Aristotle's primitive theory of terrestial motion (i.e., that the natural state of things is at rest) and Newton's First Law of Motion (i.e., that the natural state of things is at rest or in uniform motion) is precisely that the latter takes Heraclitus's insight seriously.[3] That difference is crucial for distinguishing a metaphysical system that lasted about 1900 years from Newton's systematic science of physics.

Our concern is narrower than that of any of these men, for transportation represents one of many species of change or movement. Still, it performs vital functions in all societies. Schaeffer and Sclar claimed that

> "Transportation is like the blood stream in the human body. Just as an improperly functioning blood-circulation system affects sooner or later the health of every part of the body, so an improperly functioning transportation system over time affects all aspects of society. A healthy body needs a healthy circulation system, and a healthy society requires a healthy transportation system, that is a transportation system which provides access to all."[4]

In a relatively short treatise, these authors were able to show that "cities that differ culturally but have similar transport priorities will create basic city layouts that are remarkably alike."[5] Thus, for example, the culturally distinct trading centers of Amsterdam and Osaka, and the centers of "religious or secular power," Rome, Paris, Vienna and Tokyo, developed remarkably similar layouts.[6]

Since the world is not designed such that everything one wants is in one's lap (which would require extraordinary laps), it is patently obvious that being implies moving. There is just no other way to go. "The proposition that mobility has survival value" Boulding wrote, "emerges very early in the game

of evolution."[7] What is behind this proposition, generally speaking, is that transportation is a means to or a cost that one bears in order to obtain something else.[8] It has what value theorists call 'instrumental value', as opposed to 'intrinsic value'.[9] As a report of the U.S. Department of Transportation had it, "Transportation is a service function, not an end in itself."[10]

While the instrumental value of transportation is beyond question, it's a mistake to think that nobody moves for the fun of it. I frequently walk for pleasure, and other people even go jogging and driving for pleasure. Without reviewing the immense literature on pleasures and their role in human motivation, let me just say that, for example, insofar as the pleasure of walking is inseparable from walking, the whole package (pleasurable walking) has intrinsic value.[11] Similarly, pleasurable jogging or driving, and pleasurable movement generally, may be regarded as valuable in themselves.

Just as Schaeffer and Sclar were struck by the similarities of city plans in different countries, I was surprised to find the national transportation policies of Canada and the United States articulated in such similar terms. The statement of policy of the U.S. Transportation Act of 1940 reads thus:

"It is hereby declared to be the national transportation policy of the Congress to provide for fair and impartial regulation of all modes of transportation subject to the provisions of the act, so administered as to recognize and preserve the inherent advantages of each; to promote safe, adequate, economical and efficient service and foster sound economic conditions in transportation and among the several carriers; to encourage the establishment and maintenance of reasonable charges for transportation services, without unjust discriminations, undue preferences, or advantages, or unfair or destructive competitive practices; to cooperate with the several States, and the duly authorized officials thereof; and to encourage fair wages and equitable working conditions – all to the end of developing, coordinating, and preserving a national transportation system by water, highway, and rail as well as other means, adequate to meet the needs of the commerce of the United States, of the Postal Service, and of the national defense. All of the provisions of this act shall be administered and enforced with a view to carrying out the above declaration of policy."[12]

The policy statement of the Canadian National Transportation Act of 1967 says:

"It is hereby declared that an economic, efficient and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential to protect the interests of the users of transportation and to maintain the economic well-being and growth of Canada, and that these objectives are most likely to be achieved when all modes of transport are able to compete under conditions ensuring that having due regard to national policy and to legal and constitutional requirements

(a) regulation of all modes of transport will not be of such a nature as to restrict the ability of any mode of transport to compete freely with any other modes of transport;

(b) each mode of transport, so far as practicable, bears a fair proportion of the real costs of the resources, facilities and services provided that mode of transport at public expense;

(c) each mode of transport, so far as practicable, receives compensation for the resources, facilities and services that it is required to provide as an imposed public duty."[13]

According to these statements, the governments of both countries are committed to (1) regulate all modes of transport, in the interests of (2) economic, (3) efficient, and (4) adequate transportation (5) within a system of free competition in which (6) reasonable prices are assigned to all services performed. The American statement is explicitly more humane, mentioning such things as safety, "fair wages and equitable working conditions." According to Lieb, "Controversy has surrounded the [American] policy statement since its writing. It has been argued that many of the goals of the policy statement are mutually exclusive and that it is an unworkable directive."[14] I don't see any inconsistencies in the statement, though it's always possible that certain directives will be unworkable in some situations. Indeed, there is some evidence of failure to implement the broad policies proposed in both countries. Addressing the Canadian Railway Labor Association in 1974, the Minister of Transport said

"I can't manage transportation in Canada. If you ask who is managing transportation policy, I say to you I don't know. If the transportation situation continues in the mess it is now, I don't want to stay in this job."[15]

Reviewing the impact of the Canadian Act on one mode of transportation, Lukasiewicz claimed that

" . . . since 1967 it is apparent that the 1967 Act did not produce the hoped-for competitive climate for railway transportation, and has not been effective in rationalizing rail services. Moreover, it has failed to acknowledge technological progress and service quality as factors influencing the economics of modern rail transportation.

The 1967 Act, by assuring the railways specific subsidies for uneconomic services, removes any incentive to render such services more efficient, and insures that, when judged 'in the public good,' they will continue to be operated while growing increasingly obsolescent."[16]

In the United States "Federal economic regulation affects 100% of rail and air-ton miles, 80% of pipeline, 41.3% of trucking, and only 6.7% of domestic water carriers."[17] The U.S. Department of Transportation reviewed the regulative system and issued a report in 1975 claiming that

"Carriers, shippers and passengers frequently face a web of restrictive government regulations which stifle competition, discourage innovation and foster inefficiency. The present regulatory structure is in many respects outdated, inequitable, inefficient, uneconomical and frequently irrational. It often misplaces incentive and disincentive, distorts competitive advantage, protects inefficient carriers from effective competition, overrestricts market entry, artificially inflates rates and misallocates our Nation's resources . . . . The inflexibility of these outmoded regulations impedes the development of lower cost, more efficient national transportation."[18]

Granted all the problems cited in these quotations, it's still the case that they are problems of operationalization, implementation or procedure, rather than broad policy. The national transportation policies in both countries seem to be logically coherent and generally reasonable. Unfortunately the world doesn't always accommodate such reasonableness.

3. MOTOR VEHICLES

According to the U.S. National Travel Survey of 1972, 85% of all person-trips made that year were in cars, 2% were in buses, 12% in planes, 0.4% in trains and the rest in other modes of transport (e.g., motorcycles, mobile homes, etc.).[19] The 1974 figures for Canada were very similar; 85% in cars, 3% in buses, 7% in planes, 2% in trains and the rest in other modes.[20] A person-trip is a return trip that a person takes "to a place at least 100 miles away from home."[21] The authors of the report on the American survey carefully and delightfully explain that

"The term 'person-trip' may appear superficially to correspond to a 'passenger' as normally used in common-carrier data. However, this is not the case, because the number of passengers usually represents the number of tickets or 'ticket stubs' picked up from passengers. For example, a person who went by rail from Washington, D. C., to Boston and returned could be counted as four 'revenue passengers' or more depending on circumstances. This situation arises because at least two different rail carriers would be involved on both the outbound and return segments of the trip. More specifically, a ticket stub would be picked up for the Washington to New York City segment and, because of a change in carrier at New York, a second stub would be picked up for the New York to Boston segment. A minimum of two more stubs would be counted for the return. If he were to stop over, say at Philadelphia, he would be counted as five rather than four passengers, because an additional stub would be picked up for the Philadelphia to Washington leg. In contrast, when a person is reported to have taken a trip in the National Travel Survey, he is counted as only one person-trip irrespective of the number of carriers or stop-offs (that is, ticket-stub equivalents) that may be involved in the round trip."[22]

The figures from the American and Canadian surveys demonstrate what

any moderately alert North American would grant, namely, that motor vehicles generally and the private automobile in particular dominate our transportation scene. In Volume II, Chapter 4.8 it was explained that the term 'motor vehicle' covered all kinds of passenger cars as well as trucks, buses, mobile homes, snowmobiles, motorcycles, motor scooters and trail-bikes. Reasons were also given for the fact that counts of motor vehicle registrations are not equal to counts of motor vehicles, although the former are probably our best estimates of the latter. In 1974 there were 11 million registered motor vehicles in Canada and 131 million in the United States (T1). That was an increase of 75% over 1964 in Canada and 52% in the United States. Roughly speaking then, there was a registered motor vehicle for every two North Americans.

About 25 million metric tons of motor gasoline were consumed in Canada in 1974 in order to keep all the motor vehicles running, compared to about 280 million metric tons in the United States (T2). That was an increase of 75% over 1964 in Canada, and 48% in the United States. For probably many reasons, the growth in registered motor vehicles in the United States was not matched by a growth in the consumption of motor gasoline. The 55 miles per hour speed limit on highways was initiated in the United States in the fall of 1973, while main Canadian highway speeds were never reduced below 60 miles per hour.[23] Lower average speeds would have reduced fuel consumption. In June of 1974 the CIPO asked a national sample of Canadians if they would "favour or oppose the setting of a maximum speed limit on highways of 55 miles per hour," and 56% said they would favour it (T3, F1). In October 1975 65% favoured such a limit. After living with precisely that limit for half a year, 72% of a national sample of Americans still favoured it (T3, F1). Murray *et al.* reported that in February 1974 56% of Americans in another national sample "had trouble getting gasoline."[24] So far as I know, Canadians still haven't had any trouble getting gasoline. It's also possible that on the average Americans tended to travel less than Canadians in 1974. Moreover, a different mixture of vehicle types might have accounted for the relatively lower American fuel consumption.

Views about the relative elasticity of demand for gasoline vary, partly because there is no generally accepted specification for an elastic demand. Theoretically the demand for any consumer good or service should be correlated to its price. As the correlation between price and demand increases, economists are inclined to say that the demand is elastic. But there is no rule book that requires this or that degree of correlation to be regarded as a necessary and sufficient condition of a good or service for which demand is

elastic. Senator Edward Brooke told the U.S. Senate Committee on Finance that " . . . gasoline demand is elastic, and gasoline consumption patterns can be changed without inflicting severe hardship."[25] *U.S. News and World Report* ran an article in which it was claimed that "There is little evidence that buyers are resisting stations' selling at higher prices."[26] However, that didn't demonstrate inelasticity or arrest speculation. For the article went on to say that

"There is no consensus on how high the price would have to go in this country before demand would be trimmed to the level of available supplies. There are suggestions that the market would 'clear' if prices rose to an average of 60 to 70 cents a gallon. However, a private staff study within the Federal Energy Office suggested that prices would have to go above $1 to balance demand if supplies are not increased."[27]

In an attempt to determine what impact "increased vehicle operation cost" would have on "vehicle use," a mail-out survey was undertaken in four Canadian cities (Vancouver, Edmonton, Toronto and Montreal). Respondents were offered three choices in response to increased operation costs, namely, "(1) not buying a new car as often as before, (2) not driving as much as before, and (3) no change expected."[28] Forty-eight percent said they would reduce the frequency of new car purchases, and 11% said they would reduce their travel.[29] So it was asserted that "These reactions would lead one to conclude that in any cost avoidance reaction personal mobility is kept constant. Perhaps this is one reason why there has been so much opposition to the suggestion of gas rationing to decrease vehicle use in certain U.S. states."[30]

4. PASSENGER CARS

Moving from a discussion of motor vehicles to one of passenger cars in North America is a bit like moving from a discussion of machines to one of love. Of course some people are as attached to, say, motorcycles and mobile homes as most people are attached to their cars, but the latter attachment is clearly dominant. Given my personal view of cars as nothing but useful means of transportation, I found the great North American love affair truly amazing. A report of a national survey sponsored by the U.S. Highway Research Board in 1967 concluded that

"The automobile is by far the most important mode of travel to the American household, and represents an important facet of our way of life and general values. It will become even more important in the immediate years ahead.

Attitudes toward the automobile are generally positive and the value placed on the automobile is extremely high. There appears to be close ego-involvement with the automobile as a way of life."[31]

In response to the question "The auto pollutes air, creates traffic, demolishes property, and kills people: Is the contribution the auto makes to our way of life worth this?", 84% said "yes".[32] Seventy percent reported that they were "completely" or "very much satisfied" with "the feeling of pride [they] had in the vehicle [they] rode in."[33] It's conceivable that respondents found the question bizarre (as I do) and said they were satisfied with their "feeling of pride" merely because they felt nothing at all and hence could not clearly report negative feelings. But in the context of the total set of responses in that survey, I doubt that that's what people were saying. I suspect that the authors of the report were perfectly accurate in their judgment of the ego-involvement of people with their cars.

Twelve years after the Highway Research Board's survey, the Secretary of the U.S. Department of Transportation told a *U.S. News and World Report* interviewer that "The American people will give up almost anything before their automobile – wives, children, food, houses – just about anything you might think of."[34] Exaggeration, of course . . . we hope.

On the basis of analyses of car advertisements, Schrank claimed that "The owner of an auto to some extent identifies with the car as an extension of the self . . . . 'You are what you drive' claims a sports car ad, but more likely a correct statement would be, 'You drive what you would like to be'."[35] From this perspective it's easy to see why cars are given names like Mustang, Jaguar, Matador and Fury, rather than Goldfish, Cream Puff and Pansy. Nader quite correctly remarked that "To turn the promotion of a transportation machine into an appeal so far removed from the functional quality of the machine, and to do so with commercial success, is an impressive, if disturbing, achievement in applied social science."[36]

I was unable to find any studies examining the attitudes of Canadians toward their cars. Thomas had a small mail-out survey of Canadian and American new car purchasers in the Detroit and Toronto areas in 1971. On the basis of the fact that Americans tended to have more cars per family than Canadians, he concluded that the former have "a greater automobile orientation."[37] The data presented below in T5 confirms this view, but it doesn't tell us anything about Canadian attitudes toward their cars.

There were almost 8.5 million passenger cars registered in Canada in 1974, compared to 105 million in the United States (T4). That was an increase over 1964 of 68% in the former country and a 46% increase in the latter. According

to a report by the Air Pollution Directorate of Environment Canada, the average age of the cars in Canada was 4.7 years, compared to 5.6 years for the cars in the United States.[38] The "average service lifetime" of cars in Canada and the United States was put at 9.6 and 11 years, respectively.[39]

Seventy-eight percent of Canadian households had one or more cars in 1974, compared to 84% of American households (T5, C1). In fact, the American percentages were higher than the Canadian percentages throughout the 1964–74 period, and there was less than a 10% increase over 1964 in either country.

Given the importance of private automobiles for transportation in North America, it seems reasonable to regard the percent of households with one or more cars as a positive social indicator. Hence, the United States gets 11 points for its superior stock values throughout the decade. For its superior annual flows, the United States gets 4 points and Canada gets 3.

5. DEATHS AND INJURIES

The total number of deaths resulting from motor vehicle accidents in North America is greater than the total number of combat deaths sustained by Canada and the United States in all wars.[40] In 1974, 6325 Canadians and 46 402 Americans lost their lives in traffic accidents, which meant a rate per 100 000 inhabitants of 28.2 for Canada and 22 for the United States (T6, C2).

The substantial difference between the Canadian and American rates in 1974 is not an accurate indicator of the trends throughout the decade. For 7 of 11 years the differences between the rates for the two countries were less than one person in an average of 26. American rates were preferable in 6 years and Canadian rates were preferable in 3, leaving 2 years in which the rates were identical.

As explained in Volume I, Chapter 1.6 and 3.3., some death rate indicators merit special attention, although every death has been accounted for in the crude death rates.[41] The number of motor vehicle accident deaths per 100 000 inhabitants deserves special consideration for at least three reasons. In the first place, such deaths are clearly related to a certain style of living, a style that includes a relatively big percentage of transportation in passenger cars. The extensive use of passenger cars is not inevitable, any more than their designs, their typical operation and the laws governing their use are inevitable. All of these are to a large extent the products of human design. Thus, secondly, they are in principle alterable, if not entirely manageable.

President Lyndon Johnson said, "We build the cars, the trains, the planes, the ships, the roads and the airports. We can, if we will, plan their safe and efficient use in the decades ahead to improve the quality of life for all Americans."[42] Clearly the remark is applicable to all North Americans. Finally, it should be remembered that by isolating motor vehicle accident death rates in a separate indicator, it becomes easier to address and more difficult to ignore the management problem. Accordingly, I regard the motor vehicle death rate per 100 000 inhabitants as a negative social indicator, and award Canada and the United States 3 and 6 points, respectively, for their superior stock values in our decade. For its superior annual flows Canada makes 3 points and the United States makes 7.

Since many injuries are more difficult to identify than virtually any deaths, one would expect to find wider margins of error in motor vehicle accident injury rates than in motor vehicle accident death rates. Although I don't know what these margins might be in either case, the relative status of the two must be as indicated.[43] The issue of the relative reliability of injury and death rates arises because of the conflicting pictures presented by the two series. The motor vehicle accident injury rate per 1000 population in Canada in the 1967–74 period was always lower than the American rate (T7, C3). In 1974 the former was 10.23 and the latter was 12.50, which represented a 24% increase over 1967 for Canada and a 2% decrease for the United States. Since, if all other things are roughly equal, the fewer injuries the better, we may regard these rates as negative social indicators. Hence, for its preferable stock values Canada makes 8 points, while for its preferable annual flows Canada makes 2 points and the United States makes 5.

Without pretending to provide a very thorough analysis of the issues, it still seems worthwhile to consider the causes of the colossal traffic carnage. In his classic *Unsafe at Any Speed*, Nader laid the blame squarely at the feet of the auto industry. By resisting the introduction of such safety equipment as stop lights, directional signals, windshield wipers, safety glass,[44] selt belts[45] and pollution control devices;[46] by aggressively marketing dangerous stylistic features such as "sharp fins, glare-ridden chrome, hard-tops, wrap-around windshields,"[47] tinted windshields,[48] glare-producing paint finishes[49] and engines with more power than most people ever need; and by ignoring, neglecting and often refusing to correct defects of design or manufacturing such as the "tuck-under of the rear wheels" of 1960–63 (General Motors) Corvairs,[50] "power brake units in the 1953 (GM) Buick,"[51] "runaway" transmission failures[52] and various problems affecting driver vision;[53] North American car producers have been primarily responsible, he claimed, for the

injuries and deaths on our roadways. After noting the fact that "A vast array of services – medical, police, administrative, legal, insurance, automotive repair, and funeral – stand equipped to handle the direct and indirect consequences of accident injures.",[54] he quite correctly insisted that " . . . the true mark of a humane society must be what it does about *prevention* of accident injuries, not the cleaning up of them afterward."[55]

Schrank claimed that

> " 'Accidents' are commonly thought of as being 'caused' by speeding, failing to stay awake while driving, drinking or simply losing control. . . . In reality, most accidents are not accidental at all. . . . Take the case of a drunken driver who collides head-on with another auto, killing three people. It is no accident that he was able to drive on the wrong side of the road; it is rather an expression of the fact that we are willing to take the risk of head-on collisions rather than pay for the barriers to prevent them. . . . To choose to call transportation failures 'accidents' is to risk never eliminating their root causes and to absolve the truly guilty."[56]

The President of the Insurance Institute for Highway Safety told a *U.S. News and World Report* interviewer that "Too many crashes . . . are blamed on 'driver error' which are not the driver's fault."[57] In particular, he mentioned " . . . road surfaces too slippery to stop on, brakes that don't stop the vehicle soon enough, the complex of confusing signs, poor rear lighting, faulty guard rails, roadside poles and sign posts that won't break away, and unguarded bridge abutments."[58] In response to the suggestion that "10% of the people cause 50% of the accidents," he pointed out that the correct statistic was " . . . that the worst one tenth of 1% of the drivers account for four tenths of 1% of the accidents. So, even if you take all those off the road we're still going to have 99.6% of all the accidents."[59]

The Road and Vehicle Traffic Safety Branch of the Canadian Ministry of Transport made a careful investigation of 285 traffic accidents in the 1971–1975 period in order to identify causal factors. Table 8 summarizes the factors that were isolated and categorized in a 3-by-3 matrix. All factors were divided into three broad groups, referred to simply as 'human', 'vehicular' and 'environment factors'. The accidents themselves were divided into three phases, namely, a pre-crash, crash and post-crash phase. Of the three phases, I suppose the pre-crash phase would be the one most people would be interested in when considering "the causes" of accidents. Sixty-four percent of the causal factors identified in that phase were classified as human, 26% as environmental and 10% as vehicular (T8). The human factor dominates the crash phase too, while the vehicular factor dominates the post-crash phase. It would appear then, that the information in T8 is largely incompatible

with the Nader and Schrank view. It tends to support the view that Nader attributed to a group he called "the traffic safety establishment," a group that included, for example, the National Safety Council, the Auto Industries Highway Safety Committee, the American Association of Motor Vehicles Administrators, the National Commission on Safety Education, the American Automobile Association, the Automotive Safety Foundation and the Insurance Institute for Highway Safety.[60]

The "traffic safety establishment" view was probably shared by most North Americans throughout the 1964–1974 decade, although no comprehensive data are available to prove it. In 1966 the AIPO and CIPO asked national samples in both countries "What is the chief reason for auto accidents in your opinion?" Sixty percent of Americans and 42% of Canadians answered "careless drivers" (T9, F2). Thirty-one percent of Americans and 26% of Canadians answered "speeding" which, allowing for measurement errors, means that roughly the same percentage of people in both countries mentioned this reason. Nader claimed that "Accident involvement rates are at a minimum at speeds between fifty and seventy-five miles per hour."[61] Twenty-one percent of Americans and 32% of Canadians answered "drinking," but according to an ad hoc committee of the President's Office of Science and Technology, "nearly one half of all highway fatalities are caused by intoxicated drivers."[62]

Responses to the AIPO and CIPO question "What, in your opinion, should be done to reduce the number and severity of accidents?" were also consistent with the "traffic safety establishment" view (T10). In Canada the most frequently cited four and in the United States the most frequently cited two strategies for accident reduction involved controlling human behaviour. The top two strategies in both countries were "stricter law enforcement" and "stiffer penalties for offenders," both of which make sense only if it's assumed that accidents are caused by driver negligence and official molly-coddling.

In 1968 43% of Canadians and 44% of Americans sampled by the CIPO and AIPO gave an affirmative answer to the question "In three or four European countries, a person who drives a car after having more than one drink of alcoholic beverages is sent to jail. Would you like to see such a law in this country or not?"[63]

In 1968 84% of Americans sampled by the AIPO gave an affirmative answer to the question "In some European countries automobile drivers suspected of having consumed too much alcohol are required to take a breath test or a blood test. Would you favour or oppose a law in the United States

that would require such tests?"[64] Two years later 75% of Canadians sampled by the CIPO gave an affirmative answer to the question "The law in Canada now is that automobile drivers whom police suspect as being impaired – that is, having had too much liquor – can be ordered to take a breathalizer test. Refusal to do so could bring a heavy fine. Do you agree with this law or not?"[65] The responses to these breath test questions in both countries are again consistent with the view that it is primarily human rather than machine behaviour that requires monitoring. It's a pity, however, that the AIPO and CIPO never pressed questions concerning the design and construction of motor vehicles and roadways. Here, as in other parts of this book, it seems that too much of what we have been able to see has been disfigured by our way of looking.[66]

6. RAILROADS

Among the alleged historical facts that every North American child learns about Canada and the United States, there are a plethora of stories about the role and impact of the railroads. In both countries the railroads are said to have facilitated the expansion of territorial claims, unified the rapidly overgrown nations and made a few people extraordinarily rich.[67] The 1870 British Columbian proposal to join the Dominion of Canada included the suggestion that a railroad should be built connecting that province with those in the east.[68] "The railway was again to serve as an instrument of political union," Lukasiewicz wrote.[69]

" . . . moreover, the proposed railway was needed to check the power of the American Northern Pacific Railway, a real danger to the Canadian presence in the West. Beyond political roles, the railway was to be *the* tool with which exploration, settlement and exploitation of the empty country west of the Great Lakes was to be accomplished. It was also a necessary ingredient of partisan politics. , . . If the project succeeded, the Conservative party could wield power for many years."[70]

Granting the evidence for the majority view just outlined (i.e., that railroads were built primarily in the national interest), Lukasiewicz claimed that there is also evidence that, on the contrary, the nation (Canada) was built in the interest of the railroads (i.e., those who owned the railroads).[71] The Grand Trunk and The Great Western railways were Canada's first systems.[72] The Intercolonial Railway was designed as an extended system linking the Maritime provinces with the Great Lakes.

"During a debate in the Provincial Parliament of Canada, A. A. Dorion observed that, the Intercolonial project "having failed (in 1862), some other scheme had to be concocted

for bringing aid and relief to the unfortunate Grand Trunk – and the Confederation of all the British North American provinces naturally suggested itself to the Grand Trunk officials as the surest means of bringing with it the construction of the Intercolonial Railway. Such was the origin of this Confederation scheme.' "[73]

For our purposes it doesn't matter which interests dominated the early development of the railroads. The important point is that a wide variety of interests were intended to be and were in fact served, quite apart from the interest of having a maximally efficient system of railroad transportation.[74] From the latter point of view, " . . . North American railways are obsolete in some respects, but highly efficient in others."[75] As indicators of efficiency, Lukasiewicz noted that (1) Canadian freight trains "carry 5 to 8 times the loads common in Western Europe,"[76] (2) "Except for the USSR, Canadian railways move more gross ton-miles per year per capita than other systems, about 3 times the amount typical of Western Europe,"[77] (3) "80% of train capacity is used (compared to 65% in West Germany),"[78] and (4) "trains run over much longer distances" in North America.[79] Significant technological strength in North American railroading is recognized in " . . . containerization, 'piggy-back' and unit-train operations, computerization and automation of car location identification and yard operations, among other things."[80]

Examples of inefficiencies and technological obsolescence include (1) a system of tracks in Canada of which 71% were laid before 1915 and 89% were laid before 1930.[81] (2) Almost all of the Canadian track is in single lines instead of the more efficient double track lines.[82] (3) There is "duplication and large overcapacity" in the Canadian track network.[83] (4) Canadian railways employ the largest number of persons per train-mile (about twice as many as West Germany) and pay them the most money (more than twice the European amounts)."[84]

(5) The use of electrification has barely begun in North American railroads.[85] The standard diesel locomotives used here are "more complex, more expensive and much heavier" than available electric locomotives.[86] The cost of using diesels to move a given volume of cargo has been estimated to exceed the cost of using electric locomotives by 75%.[87] "Electrics exert a larger pull than the diesels and develop more power."[88] Diesels have " . . . poorer acceleration and braking performance than is available with electrics."[89] "Diesel maintenance costs exceed electrics costs . . . by 100 to 250%."[90] Electrics produce less air and noise pollution,[91] eliminate refueling times and reduce turnaround times to permit more trips per train.[92]

(6) "North American passenger equipment has always been much heavier than the European. . . . Typical U.S. and Canadian passenger cars have a unit

weight of about 1 ton/seat, compared to European coaches at 0.35–0.6 ton/seat."[93] (7) Scheduled and actual travel speeds tend to be slow in North America as a result of track conditions, engine power, car loading and construction.[94] (8) On-time performance is poor.[95] "The on-time performance of American trains has been similar to the CN's [Canadian National's]: the fast Metroliners [between New York and Washington] achieved a 76% 'on-time' performance (compared to 73% for the *Rapido* [between Montreal and Toronto]), and the long distance trains 54% (compared to 34% for the *Super Continental* [Montreal/Toronto-Vancouver])."[96]

(9) Safety performance is relatively poor. For example,

> "In 1972, Canadian railways experienced 12 times the number of derailments, 3 times the number of collisions, and 6 times the number of collisions and derailments that occurred on French railways (per train-kilometer). The losses in life and injuries were also heavy: 15 times higher than in France among railway personnel, and 70% higher among passengers."[97]

Lukasiewicz also reported that "During the first four months of 1974, there were 2149 derailments on Penn Central. Freight cars have been known to 'derail' while standing still."[98]

Table 11 contains an assortment of railroad statistics for Canada and the United States for the years from 1968 to 1971. While their availability was largely responsible for their inclusion in this table, they do provide additional measures of the railroad systems in our two countries. Briefly, the numbers in T11 indicate that the Canadian system (1) moved relatively more goods farther (on a per capita basis), had (2) relatively more track (per thousand population), (3) higher rail revenues as a percent of GNP, (4) lighter average train loads, (5) lower rail revenues as a percent of capital investment (6) lower train frequency ratios,[99] (7) more employees per 10^5 train-miles and (8), apart from the economically disastrous AMTRAK, was generally not as profitable to operate as the American system. AMTRAK is a special case. It's a "quasi-public corporation" brought into being by the Rail Passenger Service Act of 1970 " . . . to manage the national inter-city rail passenger service network. . . . AMTRAK was originally envisioned by Congress as eventually becoming a for-profit corporation, but since its inception AMTRAK has given little promise of approaching the breakeven point."[100]

7. CARRIER COMPARISONS

Given the clear need to conserve and the equally clear demand of the transportation sector for energy, it's worthwhile to try to determine the relative

energy efficiency of different types of carriers. Writing in May 1973, Taylor claimed that there were no good estimates of fuel economy "available from any Canadian source."[101] However, four years later the Science Council of Canada issued a report in which it was claimed that "In inter-city use buses, on average, achieve over 110 passenger miles per gallon, the private automobile 45, and the airplane between 20 and 31, depending on the distance of the flight. Canadian inter-city trains demonstrate a relatively poor performance of about 25 passenger miles per gallon because of low utilization factors."[102] The following year Lieb reported that "A 1973 National Science Foundation (NSF) study said that buses generate about 85 intercity passenger miles per gallon of fuel, compared to 48, 40, and 16 passenger miles for rail, automobile, and airlines, respectively."[103]

The most thorough account of the relative energy efficiency of different types of carriers was given by Lincoln and is summarized in T12.[104] In his view a two-deck suburban train is by far the most efficient means of moving people between cities, or between cities and adjacent suburbs. It has an estimated capacity of 200 passenger miles per gallon of fuel. After that he rank-ordered buses (125 passenger mpg), trains (100–80), cars (32) and planes (22) exactly as the NSF ranked them. Although the Canadian rank-ordering begins with buses too, it differs from the American rank-orderings by placing cars above trains. I suspect, however, that the Science Council's assessments are based on efficiencies actually achieved, while the American assessments are based on efficiencies theoretically achievable. Hence, there seems to be a very good reason to press for increases in the use of buses and trains, and decreases in the use of passenger cars, namely, the relative energy efficiencies of the three types of carriers.

When freight is to be moved instead of passengers, three additional types of carriers become important. Supertankers are at the top of the list, with a capacity of 930 cargo ton miles per gallon (T12). There has been and should continue to be considerable attention paid to the safety factors related to such carriers, i.e., to the likelihood of accidents, severe oil spills and environmental degradation.[105] But it is even more important to realize that

"Ninety percent of the estimated 17 million barrels of oil spilled annually by [ordinary] tankers is spilled deliberately. The inefficiency of unloading tankers is such that large petroleum residues are not pumped out on delivery of the petroleum product to its ultimate destination. It is convenient for tankers to use seawater to clean and provide ballast in empty cargo tanks. Oil tankers coming to the United States often take back grain as a return load. Their tanks must be cleaned prior to reloading. Although this could be done in port, this would hold the ship an extra costly day. A deliberate

'accidental' oil spill on the high seas, but sometimes near a U.S. coast, is the solution too often adopted."[106]

Large pipelines (42 to 48 inches in diameter) are the second most efficient freight movers, with a capacity of 500 cargo ton miles per gallon (T12). While probably few people would think of pipelines as a significant means of moving goods, by 1978 "45% of all oil traffic" in the United States was in pipelines.[107] According to Lieb, " . . . the oil pipeline network of the United States extends more than 220 000 miles and . . . carries approximately one quarter of intercity freight ton mileage on an annual basis."[108] By 1974 the network of Canadian oil pipelines extended over 19 300 miles, from refineries in British Columbia to American markets in New York.[109] There were also over 73 000 miles of Canadian natural gas pipelines.[110]

Inland barges rank third or fourth in energy efficiency, moving an estimated 220 cargo ton miles per gallon. The vast capacity of such carriers may be appreciated " . . . when it is realized that some barges are capable of carrying as much bulk traffic as 40 railroad cars, and that tows consisting of 40 to 50 barges are possible."[111]

Trains also rank third or fourth, depending on the particular types of trains. "Three 5000-ton, 100 car freight trains" have a capacity of 250 cargo ton miles per gallon, but "fast 3000-ton, 40-car freight trains" have a capacity of 97 cargo train miles per gallon. After these carriers come trucks (50 cargo ton mpg) and planes (11 to 8 cargo ton mpg).

Energy efficiency aside, different types of carriers may be compared for safety. Table 13 gives the number and percent distribution of transportation fatalities in 1976 in Canada and the United States. Ninety percent of the Canadian and 93% of the American fatalities were accounted for by motor vehicles, reflecting the dominance of such carriers in the total transportation picture. The *relative* safety of carrier-types is summarized in T14. In 1975, for every 100 million passenger miles[112] travelled in the United States, there were 0.09 deaths in scheduled air carriers, 0.08 in railroads, 0.02 in buses and 1.2 in passenger cars. That clearly reveals the relative inefficiency of automobiles as a life-saving means of transportation, which gives us another good reason to press for decreases in the use of this type of carrier in favour of buses and trains. Giving credit where it's due, T14 also shows a remarkable record of improvement in the life-saving efficiency of all four types of carriers.

Tables 15 and 16 provide overviews of the intercity commercial passenger and freight market shares for different types of carriers in the United States from 1940 to 1975. Railroads had the biggest share of the freight market

throughout the 35 years (T15). Although there was a 40% decrease in their share since 1940, they still had 37% of the market in 1975. The airlines' share had a phenomenal growth rate of 533% over 1950, but it still constituted less than one percent of the market. Oil pipelines moved about a fourth and trucks about a fifth of the intercity freight in 1975, which represented a 155% and a 113% increase over 1940, respectively, for each type of carrier. Water carriers typically had about a sixth of the freight market throughout the period.

Airlines moved from last to first place in the business of moving people among cities (T16). By 1975 78% of the intercity commercial passenger market was controlled by airlines, representing a 232% increase over 1940. No one suffered more than the railroads, whose share dropped 91%, from 66% in 1940 to 6% in 1975. Well, "suffered" may not be the right word. According to Lukasiewicz,

> "The North American railways have a long tradition of negative attitudes towards passenger traffic. The big money has always been in freight, real estate, mining and other off-track ventures, and the railroad managements make no secret of their disdain for the passenger. In the classic words of James Hill, a 19th century President of the old U.S. Great Northern, 'A passenger train is like a male teat – neither useful nor ornamental.'"[113]

To help overcome railroad owners's reluctance to take passenger service seriously, the Canadian National Transportation Act of 1967 allowed for selected reimbursements of 80% of losses sustained in passenger operations.[114] In 1970 a similar subsidy was proposed by the U.S. Senate Commerce Committee.[115]

About half of the market share belonging to buses in 1940 was lost by 1975 (T16). In the latter year buses moved 15% of the intercity commercial passengers. Water carriers moved only 2 or 3% of the passengers annually throughout the period.

Although it's difficult to measure all the direct and indirect subsidies to different types of carriers, some roughly comparable information is available on Canadian and American government expenditures on carrier infrastructures, e.g., highways, airports, bridges, etc. For Canada in 1968, at least, "The inequality of financing of the transportation infrastructure costs is clear: while water, air and road infrastructures are subsidized to the extent of 79%, 73%, and 28% respectively, the rail infrastructure received no subsidies."[116] In 1975 82% of the total government spending in the United States for intercity transport systems went into highways, 10% into airways and airports, 3% into waterways and 3% into railroads.[117]

Presumably there is some relation between an industry's profits and the amount of government support it receives. The more operating costs an industry can pass on to the government, the greater the potential margin of profit (if all other things are roughly equal). Thus, given the enormous support American truckers have received through the development of the interstate highway system, one might have expected the motor carrier industry to have had extraordinarily high profit margins. In the latest year for which I have figures, 1969, the net income as a percent of stockholders' equity for American intercity motor carriers was 3 times higher than that for railroads (T17). But the oil pipeline companies' percentage was even higher, namely, 16% for the latter versus 11% for freight and 13% for passenger motor carriers. While the government did construct pipelines during World War II,[118] that doesn't seem to have been the typical pattern in the United States. By 1974 over two-thirds of the crude oil pipeline mileage in that country was "owned or controlled by 20 major integrated oil companies."[119] The 11% figure for freight movers was identical to the figure for the average of all manufacturing corporations in 1969 (T17).

8. TRAVEL

In the preceding five sections our attention has been focused on a variety of aspects of domestic transportation. In this section we will examine some statistics on foreign travel from Canada and the United States to one of these countries and to other countries as well. Travel to all other countries will be collectively referred to as "overseas travel", although it may not involve crossing any seas, e.g., travel to Mexico and South America.

In 1974 nearly 1.5 million Canadians and 6.5 million Americans travelled overseas (T18). That was over 6000 travellers for every 100 000 Canadians and just over 3000 for every 100 000 Americans, representing an increase over 1964 of 282% in Canada and 164% in the United States (T18, C4). Since most of this travel was undertaken as a form of recreation (i.e., it was tourism),[120] it seems reasonable to regard it as a good thing on the whole. While many or even most people might have failed to have had pleasurable trips, I have never seen any evidence of such misfortune.[121] Thus, I regard the overseas travel rate per 100 000 inhabitants as a positive social indicator. For its superior stock values on this indicator Canada makes 11 points. For its preferable annual flows Canada makes 7 points and the United States makes 3.

The number of nights spent abroad by travellers should be positively

associated with the benefits received from the trips. Still, we know that it costs money for room and board, money is a relatively scarce resource, time is also scarce, holiday and charter tours may lengthen or shorten trips beyond preferred times, and so on. I suspect, therefore, that there are relatively more external influences affecting the length of time one spends abroad than there are affecting the initiation of the trip itself. Whether that is true or not, it is certainly the case that if the length of time travelled were used as a social indicator instead of traveller rates, the result would be the same in our general assessment. Accordingly, I have decided to leave the figures for the former indicator (length of time travelled) out of our general quality of life appraisal.

In 1974 for every 1000 inhabitants there were 1574 nights spent abroad by Canadians and 353 nights spent abroad by American travellers (T19, C5). That represented a 130% increase over 1964 for Canadians and a 29% increase for Americans.

As one might expect, Canada and the United States tend to be the most frequently visited foreign country by Americans and Canadians, respectively. In 1971, for example, 73% of the visitors to the United States came from Canada,[122] which represented "91% of all international travel by Canadians."[123] In the last year for which I could find comparable statistics, 1972, about 8.7 million Canadian residents were counted returning from the United States after staying one or more nights (T20). About 13 million American residents were counted going in the opposite direction. Thus, for every 1000 inhabitants, 399 Canadian and 62 American residents were counted returning from the United States and Canada, respectively, after visiting one or more nights (T20, C6). That was an increase over 1964 of 49% for Canada and 7% for the United States.

The difficult question we have to face now is this: Should travel to Canada and the United States from the other country be regarded as a positive indicator for the sending or the receiving country? The problem arises because, if all other things are roughly equal, it's good to be able to travel (if one wants to) and it's also good to live in a country that appears to be an attractive place to live. So, for example, one could say that Canadians were better off than Americans in 1972 because the former had over 6 times the chances of travelling to another country (the United States). Alternatively one could say that Americans were better off than Canadians in 1972 because for every American showing any interest in going north there were over 6 Canadians interested in going south, i.e., Canadians were over 6 times as likely to find the United States attractive as Americans were to find Canada attractive.

Actually, the 6 to 1 figure is extremely different from anything one might

have expected on the basis of AIPO and CIPO survey results from 1974. In response to the question "Which of all the countries in the world would you be most interested in visiting?", the United States was the most frequently mentioned country by 12% of the sampled Americans *and* Canadians. The percentage differences among the top three choices in both countries were small enough to be the result of measurement errors, but Canadians ranked Great Britain and Canada second and third, respectively, while Americans ranked Great Britain and West Germany second and third, respectively. Canada was not among the top four countries mentioned by Americans.[124]

Earlier in this section I counted overseas travel as a positive indicator for *sending* countries. However, in Volume I, Chapter 2.7 I counted immigration rates and in Volume III, Chapter 6.7 I counted brain drain rates (the percent of immigrants who are highly educated) as positive indicators for *receiving* countries. So it seems to look as if I'm stuck between a rock and a hard place, acting on contradictory principles. But I'm not. The principles are not contradictory, because both are true. It's true that it's good to be able to travel and it's true that it's good to live in an apparently attractive place. The only problem is that our statistics indicate *that* people go as well as *where* people go, and the figures should be interpreted as positive or negative indicators depending on whether we focus on *that* or on *where*. We have already given credit for being able to travel, and Canada got most of it. So now I'm inclined to give credit for being the preferred destination. (For the record, I'm not inclined to think of my judgment as especially profound at this point; but it doesn't seem too bad.) Thus, regarding the rate per 1000 inhabitants of Canadians and Americans returning from the United States and Canada, respectively, after visiting one or more nights as a positive social indicator for the receiving country (i.e., a negative indicator for the sending country), the United States makes 9 points for its preferable stock values. For its superior annual flows the United States makes 5 points and Canada makes 3.

Table 21 is analogous to T19, giving the number of nights spend in Canada and the United States by visitors from the other country. So it deserves similar treatment. For every 1000 inhabitants, a bit over 2000 nights were spent in the United States by Canadian visitors, and nearly 300 nights were spent in Canada by American visitors (T21, C7). That was an increase of 37% for Canada and 25% for the United States.

A good idea of the variety of purposes of Canadian trips to the United States may be obtained from T22. In 1970, for example, 56% of Canadians returning from the United States were coming back from a holiday, 27% had

been visiting friends or relatives, and 9% were away on business. These three types of purposes were dominant every year in the 1961 to 1970 period, in precisely the order found in 1970.

Estimated costs for international travel are summarized in T23. In 1974 Canadians paid 57 (1964 U.S.) dollars per capita for overseas travel, while Americans paid 17 dollars (T23, C8). That was an increase of 67% over 1964 for Canada and 45% for the United States. While my general policy is to treat expenditure statistics as negative social indicators, the figures in T23 are included in the aggregated personal expenditure figures of T36 and they will be added to our general assessment in Section 12.

It is standard practice in the literature on travel and tourism to compare a country's receipts from foreign visitors with its expenditures on foreign visits. According to the U.S. National Tourism Resources Review Commission,

"Countries with sophisticated economies tend to have travel deficits. For example, Germany had a deficit of over $2 billion and seven of the twelve major tourist-originating countries showed a deficit of some sort [in 1971], including Canada, the Netherlands, Belgium-Luxemberg, Sweden and Japan, as well as the U.S. and Germany."[125]

Table 25 summarizes Canada's travel accounts with overseas countries in the 1959 to 1970 period. There was a deficit every year, ranging from 110 million (current Canadian) dollars in the first year to 372 million in the last. On the contrary, Canada's travel accounts with the United States in this period showed deficits in only the first three years (T26). That is almost certainly the result of the fact that Americans tend to spend more money than most people, including Canadians, when they travel.[126] As T27 indicates, for example, in 1971 the American travel account with all countries showed a deficit of 1.8 billion (current American) dollars. The American-Japanese account was the only one without a deficit that year. The National Tourism Resources Review Commission summarized its position saying that

" . . . there is indeed a travel deficit, that projections indicate it will persist, that our government procedures for dealing with foreign visitors in many cases impede their coming to this country, and that the special problems foreign visitors encounter once they are here deserve special attention."[127]

One of the special measures the Commission recommended was increased government spending for the promotion of tourism. It was pointed out, for example, that in 1970 the United States spent only 4.5 million (current American) dollars promoting tourism, while the Canadian government spent 10.4 million.[128]

9. TELEPHONES

In a recent and excellent collection of articles on the social impact of telephones, Ithiel de Sola Pool wrote that

> "Wherever we look, the telephone seems to have effects in diametrically opposite directions. It saves physicians from making house calls, but physicians initially believed it increased them, for patients could summon the doctor to them rather than travel to him. The phone invades our privacy with its ring, but it protects our privacy by allowing us to transact affairs from the fastness of our homes. It allows dispersal of centers of authority, but it also allows tight continuous supervision of field offices from the center. It makes information available, but reduces or eliminates written records that document facts.
>
> . . . the telephone contributed considerably to urban sprawl and the mass migration to suburbia. It also helped create the congested downtowns from which people are now fleeing. The telephone's role in skyscraper development is largely unknown and fascinating . . . . It also turns out that the phone had an important effect on the location of offices and factories, profoundly affecting the character of the American business elite. . . .
>
> The telephone's inherently dual effects are one reason for the paucity of literature on its social impact. Its impacts are puzzling, evasive, and hard to pin down. No matter what hypothesis one beings with, reverse tendencies also appear."[129]

Communication is certainly necessary and perhaps even close to being sufficient for the existence of communities. "We know that a growth in the size and scale of communities is always, and perhaps necessarily," Keller wrote, "associated with a change in the number and kinds of communications channels. One difference between villages and cities concerns the typical configurations of networks in each. In villages, networks tend to be overlapping, comprehensive, and in that sense closed, whereas in cities they are nonoverlapping and open-ended."[130]

Telephones are being used for an increasingly wide variety of communicative purposes, including for example, suicide prevention, crisis intervention, teen hotlines, services for the elderly, abortion counseling, counseling victims of crimes, drug hotlines, poison centers, rumor control centers, community problems information centers, tax counseling, traffic information, weather information, legal aid, wake-up services, advertising and selling products, market research, opinion polling, dial-a-prayer, dial-a-song, dial-a-friend and dial-a-joke.[131] It seems as though wherever there is a possibility of human communication, there is also a possibility of using a telephone. It would also seem to follow that wherever there is a technology for communication, there is a possibility of telephones reducing the use of or even replacing that

technology. According to Pierce, "The telephone call has definitely displaced the telegram," has probably reduced the use of mail, and has had little impact on travel and the publication of books.[132]

In 1974 96% of Canadian and 94% of American households had one or more telephones (T28, C9). Throughout the 1964 to 1974 period a greater percentage of Canadian than American households had telephones. From the first to the last year the Canadian percentage increased 9% and the American percentage increased 13%. In spite of the ambiguities mentioned by Pool, I think the benefits of telephonic communication far outweigh the costs. Indeed, no other assumption seems to provide a better explanation of the fact that such a high percentage of households in North America have telephones. Thus, I regard the percent of households with one or more telephones as a positive social indicator. For its superior stock values throughout our decade Canada gets 11 points. For its superior flows Canada makes 2 points and the United States makes 7.

There is a difference, of course, between having and using a telephone. I supposed that greater access would lead to greater use, i.e., that because telephones were available to a higher percentage of Canadian than American households, Canadians would tend to use them more frequently. I was wrong. In 1974, for example, every Canadian had an average of 2.53 conversations on the telephone every day, compared to 2.89 conversations for every American (T29, C10). Throughout the decade it was typical for Americans to have more conversations per day on the average than Canadians. The American average also grew a bit more rapidly in the period (61%) than the Canadian (49%).

According to Mayer, "All studies show that between 40 and 50 percent of the telephone calls originating from a household are made within a two-mile radius. In short, people make most of their telephone calls within the neighbourhood in which they live."[133] In an urban study it was found that "About half the calls from the median urban household . . . go to only five different numbers."[134] A statewide study found that the average length of time spent per call was 4¼ minutes.[135]

"Everywhere, the total telephone bill tends to rise with the income level of the household. . . . the network is most heavily used on certain days, Mother's Day being the most notorious, and during certain parts of the day. Volume rises dramatically on wet days . . . . Workers in the bowels of a telephone company central office in a northern climate, entombed though they are between windowless walls, are among the first to know that it is snowing, because the relays start clacking. Before anyone had carried the news into their areas, these workers also knew that something terrible had happened on the afternoon of Jack Kennedy's assassination, because all the networks went busy at once."[136]

Assuming that the point of having a telephone is to improve one's communication network, that if all other things are equal a wider is preferable to a narrower network and that the wider the network the more frequently it will be tapped, it is reasonable to assume that the more telephone conversations one has per day, the better off one is. In this stark form the assumption looks naive. No one would try to improve the quality of his or her life by merely increasing the average number of telephone conversations per day. One might, but we don't have to accept that conclusion any more than we had to accept the equally absurd conclusion that, say, the quality of life of everyone, under all circumstances, could be improved by having more park visits, more television sets, and so on.[137] All that's required in the present case is the fairly modest assumption that a person with a relatively more active telephone communication network is a bit better off than a person with a relatively less active network, if all other things are roughly equal. This assumption is tantamount to regarding the daily average number of telephone conversations per person as a positive social indicator. Hence, the United States makes 11 points for its superior stock values for this indicator. For its superior flows, the United States make 6 points and Canada makes 4.

Tables 30 and 31 simply break up the information on telephone calls into local and long distance calls. Americans typically made more of each kind of call than Canadians.

10. MAIL

"Who would want to see railway services deteriorate to the extent the post office services have declined in recent decades?" Lukasiewicz asked, pressing postal services a notch below the nadir of North American industries.[138] As these sentences are being written, Canadians have just had their sixteenth strike of post office workers in as many years. A couple months before the strike, newscasters were heralding this year as the first in 16 years that a postal strike would be averted. So much for heralding. A line from a *Newsweek* article written seven years earlier seems to be appropriate to Canada and the United States then, now and throughout the 1964 to 1974 period, i.e., " . . . millions of Americans are convinced that deteriorating is about the only thing the post office is doing rapidly at all."[139]

The standard sort of defence offered by post office managers was expressed as follows by the Postmaster General of the United States. "Does anyone know of any operation that runs at 99% effectiveness? . . . We handle about 90 billion pieces of mail. If we perform with 99% effectiveness, we expose

ourselves to 900 million gripes."[140] At that point in time, the Canadian postal service handled about 6 billion pieces of mail per year, exposing itself to 60 million gripes if it were 99% effective. It's unlikely that any North American post office operates with 99% effectiveness. So we're probably lucky that most people with a legitimate complaint don't take it to its source. Even if the complaints weren't mailed in, the extra remedial activity undertaken would almost certainly overwhelm the already overburdened post offices and drive their effectiveness and efficiency to even lower depths.

Although the road to postal service reform does not seem to lie with grass roots citizen intervention, other roads are open. In the United States,

"In the years preceding the Postal Reorganization Act, the Post Office Department was engaged in what the Postmaster General termed a 'race with catastrophe.' In December 1963 and in October 1966 major breakdowns in the postal system resulted in millions of parcels and letters being delayed for extended periods. While the immediate causes of these breakdowns were identifiable and correctable, they were merely symptomatic of an organization that was in deep trouble. The Post Office Department's difficulties were caused by a series of interrelated problems including

- a management system that rendered impotent those in a position of responsibility,
- an antiquated physical plant incapable of handling the ever increasing volume of mail,
- a lack of mechanization necessitating vast armies of people to move the mails, and
- a workforce that suffered from poor pay, poor working conditions, poor career opportunities, and poor morale.

Recognizing the malaise inherent in the Post Office Department, the President established the Commission on Postal Organization in 1967.

In its 1968 report, the Commission recommended the establishment of an independent postal service free of the operating constraints that had plagued the Post Office Department. These constraints were best expressed in a short exchange between the Postmaster General and the Chairman of the Post Office's appropriations subcommittee:

> Mr. Steed: General . . . would this be a fair summary: that at the present time, as the manager of the Post Office Department, you have no control over your workload, you have no control over the pay rates of the employees that you employ, you have very little control over the conditions of the service of these employees, you have virtually no control, by the nature of it, of your physical facilities, and you have only a limited control, at best, over the transportation facilities that you are compelled to use – all of which adds up to a staggering amount of 'no control' in terms of the duties you have to perform . . .
>
> Mr. O'Brien: Mr. Chairman, I would have to generally agree with your premise . . . that is a staggering list of 'no control.' I don't know (whether) it has ever been put that succinctly to me. If it had been at an appropriate time, perhaps I wouldn't be sitting here.

The Congress was persuaded by the arguments advanced for an independent Postal Service and passed the Postal Reorganization Act in August 1970. The Postal Service began operations in July 1971, amidst high expectations of improved performance."[141]

North of the border,

"At the time of the settlement of the strike in the latter part of July 1965, which had interrupted postal service at many locations in Canada, the Canadian Postal Employees' Association (now known as the Canadian Union of Postal Workers), the Federated Association of Letter Carriers (now known as the Letter Carriers' Union of Canada) and the Canadian Railway Mail Clerks' Federation requested an inquiry into the working conditions of postal employees. The Government agreed with this request. On the first of September 1965, on the recommendation of the Committee of the Privy Council, His Excellency the Governor General approved Order in Council P.C. 1965–1590 which began as follows: . . .

'The Committee of the Privy Council, on the recommendation of the Postmaster General, advise that Mr. Justice Andre Montpetit, Montreal, Quebec, be appointed a Commissioner under Part I of the Inquiries Act to inquire into the Post Office Department concerning grievances relating to work rules, codes of discipline and other conditions of employment applying to non-supervisory operating employees, exclusive of salaries; in doing so, to consult with officers of the Department and of organizations representing employees; and, keeping in mind both the welfare of employees and the efficient operation of the postal service, to report thereon and to recommend such changes in existing practices as may be in the public interest.' "[142]

The Royal Commission did find some serious "human relations problems." "Except in one or two districts [out of 14], the attitude of some supervisors and postmasters towards their employees [left] much to be desired."[143] But there were other factors too.

"The rapid expansion of our country has had repercussions on the whole postal service; the almost unforeseeable increase in the volume of mail, the rapid development of several large centres, the movement of population, the necessary recourse to more modern means of transportation, the difficulties of recruiting labour in some places, the competition of large industries with regards to wage levels and general working conditions, the increase in night work, the make-up of a larger number of shifts at unusual hours, etc."[144]

In the light of our experience with the postal service since the issuance of the Commission's report, it's fair to say that the system still has some bugs. So does the American system. However, so far as our story is concerned, the real pity is not that the systems are defective, but that there are no available statistics to measure the defects. The few numbers we do have are not very revealing.

In 1976 the U.S. Postal Service estimated the amount of time average citizens in 11 countries would have to work to pay for the postage of a first class letter. "Of the citizens of the 10 [other] countries," the Service found, "only the Canadians work less time for postage than do U.S. workers."[145] While Americans had to work about a minute and 22 seconds, Canadians had to work about 54 seconds (T32).

The only directly relevant time series available concern the volume of mail moved by the postal services. In 1974 for every Canadian there were 149 pieces of first class mail moved, compared to 252 pieces for every American (T33, C11). That was an increase over 1965 of 34% in Canada and 25% in the United States. There were 51 pieces of third class mail moved for every Canadian in 1974, and 107 pieces for every American.

In North America about three-quarters of the mail originates from businesses.[146] So a former Postmaster General was not exaggerating when he said that " . . . we should appreciate that much is at stake when we talk about the future of the mail system, for its health goes to the heart of the nation's economic vitality."[147] The Canadian Royal Commission on Government Organization was even more dramatic.

"The operations of the Post Office are many and varied – forwarding personal and business correspondence, distributing information, transporting goods, facilitating financial settlements, widespread distribution of advertising and promotional material, and other services. These familiar tasks, woven into the fabric of our daily existence, affect local life, social interests and business operations in every neighbourhood. The Post Office, in performing them, is more than a vast public utility. It is a unifying force throughout the country."[148]

Granting the importance of mail as a feature of our communication system and following the line of reasoning used in the previous section on the frequency of telephone conversations, I'm inclined to regard the number of pieces of first class mail moved annually for each inhabitant as a positive social indicator. Hence, for its superior stock values throughout the 1965 to 1974 period, the United States makes 10 points. For its superior annual flows, the United States makes 4 points and Canada makes 5.

11. NEWSPAPERS

In Volume II, Chapter 5.3 to 5.8 I considered the role of informed citizen participation in democracies generally, and in Canada and the United States in particular. Virtually all democrats have recognized free expression as a necessary condition of the rational discussion of public issues, and a free press as a species of such expression. In 1938 Chief Justice Lyman Duff of the Supreme Court of Canada explained "the *rationale* for freedom of the press in Canada" according to the British North America Act.[149] As he saw it,

"The preamble of the statute . . . shows plainly enough that the constitution of the Dominion is to be similar in principle to that of the United Kingdom. The statute

contemplates a Parliament working under the influence of public opinion and public discussion. There can be no controversy that such institutions derive their efficacy from the free public discussion of affairs, from criticism and answer and counter-criticism, from attack upon policy and administration and defence and counter-attack; from the freest and fullest analysis and examination from every point of view of political proposals .... The right of public discussion is, of course, subject to legal restrictions; those based upon considerations of decency and public order, and other conceived for the protection of various private and public interests with which, for example, the laws of defamation and sedition are concerned. In a word, freedom of discussion means ... 'freedom governed by law'.

Even within its legal limits, it is liable to abuse and grave abuse and such abuse is constantly exemplified before our eyes; but it is axiomatic that the practice of this right of free public discussion of public affairs, notwithstanding its incidental mischiefs, is the breath of life for parliamentary institutions."[150]

In his opening remarks to the Subcommittee on Constitutional Rights of the U.S. Senate Committee on the Judiciary hearings on freedom of the press, Senator Sam J. Ervin, Jr. said,

"Our historic commitment to freedom of the press means that we must tolerate absurd, misleading, and vindictive reports which sometimes appear in newspapers, magazines, and on radio and television. It means that thoughts and ideas which we hate and despise will appear in print and be broadcast across the land. James Madison recognized that some degree of abuse is inseparable from the proper use of everything; and in no instance is this more true than in that of the press. Most Americans have come to understand that the irritating excesses of the press are a small price to pay for a press independent of Government control. They realize that only an independent press can vigorously and effectively contribute to that wide ranging and critical discussion of public affairs which is a prerequisite to a democratic society."[151]

Although Canadian and American ideas about freedom of the press evolved out of a common British heritage, at least one author has tried to draw a distinction between the North American species. According to Westell,

" ... what we should be able to avoid in Ottawa is the importation of the U.S. idea that the press is a natural adversary of government.

In the U.S. System of government, this may be so. Instead of an adversary politics, there is a distribution of power among several branches of government. The President may oppose Congress on some issues, the Congress may legislate its way around the Supreme Court, the Court may discipline the President. But all are branches of the same government and there is no opposition offering an instant alternative. In this situation, the press may be justified in regarding itself as the watchdog, critic and adversary of government, and indeed its role in the political system is recognized and protected in the constitution.

In Canada, the situation is utterly different. The watchdogs, critics and adversaries are the opposition parties on the floor of Parliament, daily confronting and challenging

the government and ready at a moment's notice to assume executive power and responsibility. The public therefore does not need another opposition in the form of the press. It needs a full and fair account of the actions of government and the criticisms of the opposition so that it can form a judgment about which to entrust with power.

This is not to say that reporters will never find themselves in an adversary relationship with some branch of government. Politicians and civil servants sometimes want to keep secret information which should be public and it is the reporter's job to beat them if he can.

Nor should there be confusion between the roles of adversary and investigator. . . . the press should be doing a great deal more to investigate and analyse the activities of government. In so doing, it would turn up some material favorable to the government and other material which would strengthen the opposition parties by providing ammunition for debate and criticism in the House of Commons. The point is that the primary role of the media should be that of the fair reporter and not that of the adversary with a duty to balance the power of government or even to bring down the government, as many political journalists now seem to imagine. It is simply easier and very much more flattering to regard oneself as a crusading journalist-confronting the Prime Minister and the bureaucracy, shaping public opinion, exercising political influence-than it is to be a conscientious reporter."[152]

While Westell has drawn a nice distinction, I know of no evidence indicating that many or most Canadians (or Canadian journalists) would accept it. It seems to have been directly contradicted by the Canadian Special Senate Committee on Mass Media when they wrote that

"We hope the media will not be reluctant to embarrass the powerful. If the press is not a thorn in the side of the Establishment, it's a wart on the body politic. Try thinking of the press as the loyal opposition, or a countervailing force."[153]

In the presence of the heady quotations that I have just passed before you, the absence of directly relevant measures of a free press in North America is, to say the least, disappointing. The time series we do have, on numbers of daily newspapers and circulation, tell us virtually nothing about the quality or value of the publications. In 1974 there were 121 daily newspapers published in Canada and 1768 in the United States (T34). These papers appeared with distinct names, were staffed in large measure with distinct personnel and contained fairly distinct content. Hence, although several of these papers might have been owned by a single owner, an abstract corporate entity most likely, it's fair to regard them as distinct publications.[154]

In round figures, one could say then, that in 1974 there was about half of a newspaper publishing firm for every 100 000 Canadians, and about 80% of such a firm for every 100 000 Americans. The Canadian percentage declined 13% since 1964 and the American percentage declined 9%. The total

circulation of these papers was such that in 1974 every Canadian had access to about 20% of a newspaper, compared to about 30% for every American (T35). Those percentages were practically unchanged throughout the 1964 to 1974 period.

Granting that aggregated daily newspaper circulation figures are a long way from being valid measures of the quality of public affairs communication, they do represent one aspect of such communication. People read newspapers to find out what's going on in their world, and the greater the circulation of papers, the greater the access to such information (if all other things are equal). On this thin thread I'm hanging the judgment that per capita daily newspaper circulation may be regarded as a positive social indicator. Hence, for its superior stock values on this indicator the United States makes 11 points. Since the flows were negligible in both countries in our period and the thread is indeed thin, I'm awarding no points for flow values.

The Canadian Special Senate Committee on Mass Media was unabashedly chauvinistic. "We think newspapers in general are much better in Canada than they are, in general, in the U.S." the Committee reported, without mentioning any evidence for the judgment.[155] Results from the Committee's national opinion poll in 1970 indicated that (1) "About half the people [feared] that newspapers might invade their privacy; their fear of radio and TV [wasn't] as great in this respect."[156] (2) "A large majority felt they were getting biased information about politicians (but also felt that in general the media do a good job in reporting politics)."[157] (3) "About two thirds of the sample felt that 'big business' was to blame for press bias . . . ."[158] (4) Forty percent "felt that newspapers serve the interests of advertisers or the government, rather than the public at large."[159] (5) "Nearly nine of ten Canadians [felt they were] better informed . . . than they were five years ago."[160] (6) About half the sample felt "that newspapers and radio should be censored."[161] (7) Thirty percent didn't think that the media were "sufficiently critical of government."[162] (8) Sixty-eight percent were "satisfied with the amount of news they [were] getting."[163] (9) Although the Committee regarded Nova Scotia and New Brunswick as "journalistic disaster areas," they found that "Nova Scotians [felt] better informed than do British Columbians."[164]

In response to the CIPO question "Generally speaking, where do you feel you get the most reliable news coverage – from newspapers, radio, or TV?", in 1970 40% of a national sample of Canadians answered 'TV,' 30% answered 'newspapers' and 21% answered 'radio'.[165] The following year the question was raised "Thinking about the newspaper you read most – on the whole do you feel that it does a good job, or not a good job, of presenting the news?"

Forty-nine percent thought their newspaper did a good job, 30% a fair job and 15% a poor job.[166]

Americans were not as satisfied as Canadians with media coverage of the news. In response to the AIPO question "What about the newspapers – in presenting the news dealing with political and social issues – do they deal fairly with all sides or do they tend to favor one side?", in 1969 45% of a national sample replied 'unfair' and 37% replied 'fair'.[167] When the question was put about television, 42% answered 'unfair' and 40% 'fair'.[168]

Roper and Associates put the following question to Americans in 1964 and 1968: "If you got conflicting or different reports of the same news story from radio, television, the magazines, and the newspapers, which of the four versions would you be most inclined to believe – the one on the radio or television or magazines or newspapers?". In 1968 44% favoured television and 21% favoured newspapers. Four years earlier television had 41% and newspapers had 23%.[169] Apparently then, for Canadians (in 1970) and Americans (in 1964 and 1968) seeing tended to breed believing. The only evidence available that is not entirely consistent with the view that North Americans put more trust in television than in newspapers is in the six national surveys cited in Volume III, Chapter 6.11, T23. Allowing for measurement errors, in each of the surveys from 1966 to 1976, roughly the same percentage (from 17 to 29%) of Americans expressed "a great deal" of confidence in leaders of the press and television.

Given the problems with television's vision of reality that were discussed in Volume III, Chapter 8.4, one should not be sanguine about the public's perception of the reliability of television newscasts. Indeed apart from that discussion, Altheide's penetrating analysis of the systematic distortion of events by television newscasters in the interests of technological, practical and commercial requirements should provoke serious concern. This is not the place to review all the issues raised by Altheide, but it is worthwhile to present a few of his basic ideas. In his own words,

> " . . . events become news when transformed by the news perspective, and not because of their objective characteristics. A related point is that news practices can significantly alter one event by either predefining what is most important about it or by retrospectively connecting it to other events.
>
> The way newsworkers look at the world was shown to be influenced by commercialism, political influence, technology, and scheduling demands. These concerns become problems which must be solved if news is to be presented in a concise and entertaining way. The solution is what I have termed the news perspective, or the view that for practical purposes, events can and should be summarily presented as a narrative account with a beginning, middle, and end. It must be emphasized that, within the various news

organizations I have studied, the reliance on and use of this perspective is morally sanctioned in the form of job security, collegial praise, and journalistic awards. Thus, organization has prompted practices which obfuscate the events-presented-as-news for practical reasons. Rules of thumb, editing techniques, marketing research, use of themes and angles, and even writing a story to fit with another to make the 'show flow,' has become the rational way to change the world in order to present it as news.

This is the kind of news millions of people receive each night, and this is why I have argued . . . that the news process is itself a medium through which the world is viewed, selected, and then presented. It is the scene for significant events. My observations led me to the conclusion that *television news is most accurately conceived as a medium for presenting useful reports (e.g., organizational, personal, and political) as though they were derived for their truth, objectivity and adequacy*. The overriding practical commitments of local TV news have been substituted for more objective reports about social life.

The place of TV news in our everyday lives demands that everyone know how to watch it. This is necessary because our pictures of reality are distorted by the work which transforms events into news stories. We must realize that many events-presented-as-news are irremediably influenced by these prior commitments. A first step toward understanding our lives and knowing what is going on in our world is to become aware of the news process."[170]

12. EXPENDITURES

Throughout the 1964 to 1974 period American personal expenditures per capita on transportation and communication were higher than their Canadian counterparts. In 1974, for example, Americans spent 401 (1964 U.S.) dollars per person in this area, compared to 361 dollars spent by Canadians (T36, C12). That was a 30% increase over 1964 for Americans and a 63% increase for Canadians. Following my general policy of treating expenditure statistics as negative social indicators, Canada makes 11 points for its preferable stock values on this indicator. For its preferable annual flows Canada makes 4 points and the United States makes 6.

13. SUMMARY AND RESULTS

The results of my comparative assessment based on the 10 usable social indicators identified in this chapter are summarized in the following matrix.

SOCIAL INDICATOR	CANADA STOCK	CANADA FLOW	USA STOCK	USA FLOW
1. Households with cars	0	3	11	4
2. Motor vehicle accident deaths	3	3	6	7
3. Motor vehicle accident injuries	8	2	0	5
4. Overseas travel	11	7	0	3
5. Canadian/American travel	0	3	9	5
6. Households with telephones	11	2	0	7
7. Telephone conversations	0	4	11	6
8. First class mail	0	5	10	4
9. Newspaper circulation	0	0	11	0
10. T and C personal expenditures	11	4	0	6
T and C Subtotal	44	33	58	47
T and C Total	77		105	
Previous Total	595		470	
Combined Total	672		575	

With respect to the general area of transportation and communication, the quality of life in the United States is higher than that in Canada. The final area score is 105 to 77. If the results of previous chapters are added to those of this chapter, the quality of life in Canada still looks higher than that in the United States. The combined score is 672 to 575.

If one looks at the first and last recorded stock values for the usable indicators for each country independently of the other country, one may get a sense of the direction in which the two countries have been moving. The results of this examination are summarized below.

SOCIAL INDICATOR	CANADA BETTER	CANADA WORSE	USA BETTER	USA WORSE
1. Households with cars	1	0	1	0
2. Motor vehicle accident deaths	0	1	1	0
3. Motor vehicle accident injuries	0	1	1	0
4. Overseas travel	1	0	1	0
5. Canadian/American travel	0	1	0	1
6. Households with telephones	1	0	1	0
7. Telephone conversations	1	0	1	0
8. First class mail	1	0	1	0
9. Newspaper circulation	0	0	0	1
10. T and C personal expenditures	0	1	0	1
T and C Total	5	4	7	3
Previous Total	35	24	30	27
Combined Total	40	28	37	30

In the area of transportation and communication, the United States improved in more ways and deteriorated in fewer ways than Canada. When these results are added to those of previous chapters, Canada's general picture looks better than that of the United States. Canada has both improved in more ways and deteriorated in fewer ways than the United States. However, both countries have improved in more ways than they have deteriorated.

Putting all evaluations aside, the countries have tended to be or become similar with respect to the following.

1. Motor vehicle accident injuries
2. Canadian/American nights visiting
3. Households with telephones
4. Newspaper circulation
5. T and C personal expenditures

The countries have tended to be or become dissimilar with respect to the following.

1. Households with cars
2. Motor vehicle accident deaths
3. Overseas travel
4. Number of nights spent abroad by travellers
5. Canadian/American travel
6. Travel payments
7. Telephone conversations
8. First class mail
9. Daily newspapers

In the area of transportation and communication then, the two countries tended to be or become dissimilar in more ways than they tended to be or become similar. If these results are added to those of previous chapters, then there are a total of 91 nonindependent paths that have tended to converge and 103 that have tended to diverge. These are summarized below.

	NUMBERS OF NONINDEPENDENT PATHS TENDING TO	
	CONVERGE	DIVERGE
T and C	5	9
Previous Total	86	94
Total	91	103

Considering only the most recent point at which the same question was

raised by the AIPO and CIPO or some other survey research team, Canadians and Americans gave essentially the same responses to 4 out of 6 questions. Briefly these were:

1. Speeding, chief auto accident reason, 1966
2. Strategies for reducing accidents, 1966
3. Jailing drivers who drink, 1968
4. Country most interested in visiting, 1974

Essentially different responses were given to two questions, namely,

Chief auto accident reason, 1966

1. (a) Careless drivers
   (b) Drinking

If these results are added to those of previous chapters, then there are a total of 31 questions which Canadians and Americans answered in essentially similar ways and 35 more which they answered in different ways. That is:

	SURVEY QUESTIONS FOR WHICH ANSWERS WERE ESSENTIALLY	
	THE SAME	DIFFERENT
T and C	4	2
Previous Total	27	33
Total	31	35

Very briefly then, the combined evidence of this and previous chapters yields precisely the same three conclusions mentioned at the end of Chapter 9.

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[19] U.S. Department of Commerce, *National Travel Survey* ('1972 Census of Transportation, Volume I') (Washington: U.S. Government Printing Office, 1974), p. xvii, Table C.
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[30] *Ibid.*, p. 11.
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[32] *Ibid.*, p. 20, Table 44.

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[38] G. W. Taylor, *Automobile Emission Trends in Canada 1960–1985* (Ottawa: Air Pollution Control Directorate, Environment Canada, 1973), p. 5.
[39] *Ibid.*
[40] Lieb, *op. cit.*, p. 357; C. P. Stacey, *Six Years of War: The Army in Canada, Britain and the Pacific* (Ottawa: Queen's Printer and Controller of Stationary, 1967), pp. 4, 524.
[41] Volume I, Chapter 2.6, Table 24.
[42] L. B. Johnson, 'A President Surveys Transportation', *Problems of Mass Transportation*, (ed. by D. Reische) (New York: The H. W. Wilson Co., 1970), p. 38.
[43] The problems here are similar to those involved with distinguishing common versus aggravated assault. See Volume II, Chapter 4.3.
[44] Nader, *op. cit.*, p. 222.
[45] *Ibid.*, pp. 96–110.
[46] *Ibid.*, pp. 126–145.
[47] *Ibid.*, p. 286.
[48] *Ibid.*, p. 55.
[49] *Ibid.*, pp. 57–58.
[50] *Ibid.*, pp. 1–28.
[51] *Ibid.*, pp. 36–42.
[52] *Ibid.*, pp. 47–50.
[53] *Ibid.*, pp. 52–56.
[54] *Ibid.*, p. lxxiv.
[55] *Ibid.*
[56] Schrank, *op. cit.*, p. 77.
[57] 'Making it Safer to Drive – What's Happened, What's Ahead', *U.S. News and World Report*, July 24, 1972, p. 74.
[58] *Ibid.*
[59] *Ibid.*
[60] Nader, *op. cit.*, pp. 199–252.
[61] *Ibid.*, p. 249.
[62] Lieb, *op. cit.*, p. 359.
[63] CIPO release February 21, 1968.
[64] AIPO #771, November 1968.
[65] CIPO #341, May 1970.
[66] Compare, for example, Volume II, Chapter 5.14.
[67] Lieb, *op. cit.*, pp. 6–8; Lukasiewicz, *op. cit.*, p. 8. Following Lukasiewicz's splendid treatise, this section has more information on Canada than on the United States.

[68] Lukasiewicz, *op. cit.*, p. 10.
[69] *Ibid.*
[70] *Ibid.*, pp. 10–11.
[71] *Ibid.*, p. 14.
[72] *Ibid.*, p. 6.
[73] *Ibid.*, p. 14.
[74] *Ibid.*, pp. 55–62.
[75] *Ibid.*, p. 55.
[76] *Ibid.*
[77] *Ibid.* A ton-mile equals the result of multiplying numbers of tons by numbers of miles.
[78] *Ibid.*, p. 56.
[79] *Ibid.*
[80] *Ibid.*, p. 62.
[81] *Ibid.*, p. 47.
[82] *Ibid.*, p. 45.
[83] *Ibid.*, p. 47.
[84] *Ibid.*, p. 56.
[85] *Ibid.*, pp. 56–57.
[86] *Ibid.*, p. 65.
[87] *Ibid.*
[88] *Ibid.*
[89] *Ibid.*, p. 66.
[90] *Ibid.*, p. 72.
[91] *Ibid.*, p. 74.
[92] *Ibid.*
[93] *Ibid.*, p. 75.
[94] *Ibid.*, pp. 83–87.
[95] *Ibid.*, pp. 87–92.
[96] *Ibid.*, p. 92.
[97] *Ibid.*, pp. 96–97.
[98] *Ibid.*, Plate 23.
[99] The train frequency ratio is "the ratio of train-miles per day to the total network route miles." *Ibid.*, p. 60.
[100] Lieb, *op. cit.*, pp. 261–262.
[101] Taylor, *Automobile Emission . . .*, p. 5.
[102] Science Council of Canada, *Canada as a Conserver Society: Resource Uncertainties and the Need for New Technologies* (Ottawa: Minister of Supply and Services, 1978), p. 42.
[103] Lieb, *op. cit.*, p. 72.
[104] G. A. Lincoln, 'Energy Conservation', *Science* (1973), 155–162.
[105] For example, see W. B. Travers and P. R. Luney, 'Drilling, Tankers, and Oil Spills on the Atlantic Outer Continental Shelf', *Science* (1976), 791–796.
[106] *Ibid.*, p. 795.
[107] Lieb, *op. cit.*, p. 81.
[108] *Ibid.*, p. 78.
[109] Statistics Canada, *Canada Year Book 1976–77* (Ottawa: Minster of Supply and Services, 1977), p. 651.

[110] *Ibid.*, p. 652.
[111] Lieb, *op. cit.*, p. 95.
[112] Passenger miles equal the product of multiplying numbers of passengers by estimated straight-line distances travelled. U.S. Department of Commerce, *op. cit.*, pp. ix and A2.
[113] Lukasiewicz, *op. cit.*, p. 143.
[114] *Ibid.*, p. 123.
[115] 'What's Being Planned to Save Rail Travel', *U.S. News and World Report*, January 19, 1970, p. 58.
[116] Lukasiewicz, *op. cit.*, p. 184.
[117] Lieb, *op. cit.*, p. 5, Table 1–1.
[118] *Ibid.*, p. 80.
[119] *Ibid.*, p. 82.
[120] This is suggested by T22 of this chapter.
[121] Recall my discussion in Volume I, Chapter 1.6 on the equal weighting of all indicators.
[122] National Tourism Resources Review Commission, *International Visitors* ('Destination USA, Volume 3'), (Washington: U.S. Government Printing Office, 1973), p. 4.
[123] *Ibid.*, p. 6.
[124] CIPO release May 18, 1974; *Gallup Opinion Index*, May 1974, p. 13.
[125] National Tourism Resources Review Commission, *op. cit.*, p. 3.
[126] *Ibid.*, p. 21.
[127] *Ibid.*, p. 1.
[128] *Ibid.*, p. 22.
[129] I. De Sola Pool (ed.), *The Social Impact of the Telephone* (Cambridge, Massachusetts: MIT Press, 1977), pp. 4–5.
[130] S. Keller, 'The Telephone in New (and Old) Communities', *The Social Impact of the Telephone*, (ed. by I. de Sola Pool) (Cambridge, Massachusetts: MIT Press, 1977), p. 283.
[131] D. Lester, 'The Use of the Telephone in Counseling and Crisis Intervention," *The Social Impact of the Telephone*, (ed. by I. de Sola Pool) (Cambridge, Massachusetts: MIT Press, 1977), pp. 455–456.
[132] J. R. Pierce, 'The Telephone and Society in the Past 100 Years', *The Social Impact of the Telephone*, (ed. by I. de Sola Pool), (Cambridge, Massachusetts: MIT Press, 1977), pp. 164–169.
[133] M. Mayer, 'The Telephone and the Uses of Time', *The Social Impact of the Telephone*, (ed. by I. de Sola Pool), (Cambridge, Massachusetts: MIT Press, 1977), p. 226.
[134] *Ibid.*, p. 228.
[135] *Ibid.*
[136] *Ibid.*, p. 234.
[137] Recall my discussion in Volume I, Chapter 1.6 on monotonic increasing quantities.
[138] Lukasiewicz, *op. cit.*, p. 191.
[139] 'The Big Postal Snafu', *Newsweek*, April 9, 1973, p. 97.
[140] 'What's Wrong with the Mails', *U.S. News and World Report*, March 19, 1973, p. 33.
[141] U.S. Senate, Committee on Post Office and Civil Service, *Problems of the U.S. Postal Service*, 94th Cong., 2d Sess., 1976, pp. 20–21.
[142] Royal Commission of Inquiry into Working Conditions in the Post Office Department, *Report* (Ottawa: Queen's Printer and Controller of Stationary, 1966), p. i.

[143] *Ibid.*, p. 17.
[144] *Ibid.*, p. 21.
[145] U.S. Senate, Committee on Post Office and Civil Service, *op. cit.*, p. 18.
[146] *Ibid.*, p. 125.
[147] *Ibid.*, p. 156.
[148] The quotation is from the Royal Commission of Inquiry into Working Conditions in the Post Office Department, *op. cit.*, p. 4.
[149] G. S. Adam, 'The Sovereignty of the Publicity System: A Case Study of the Alberta Press Act', *Journalism, Communication and the Law*, (ed. by G. S. Adam) (Scarborough, Ontario: Prentice-Hall of Canada, Ltd., 1976), p. 167.
[150] *Ibid.*, pp. 167–168.
[151] S. J. Ervin, Jr. in the U.S. Senate, Committee on the Judiciary, Subcommittee on Constitutional Rights, *Hearing, Freedom of the Press*, 92nd Cong., 1st and 2 Sess., 1971 and 1972, pp. 3–4.
[152] A. Westell, 'Reporting the Nation's Business', *Journalism, Communication and the Law*, (ed. by G. S. Adam) (Scarborough, Ontario: Prentice-Hall of Canada, Ltd., 1976), p. 67.
[153] Special Senate Committee on Mass Media, *The Uncertain Mirror* ('Mass Media, Volume I') (Ottawa: Queen's Printer for Canada, 1970), p. 258.
[154] *Ibid.*, p. 5.
[155] *Ibid.*, p. 142.
[156] *Ibid.*, p. 84.
[157] *Ibid.*
[158] *Ibid.*
[159] *Ibid.*
[160] *Ibid.*
[161] *Ibid.*, p. 83.
[162] *Ibid.*
[163] *Ibid.*, p. 233.
[164] *Ibid.*, p. 84.
[165] CIPO release February 28, 1970.
[166] CIPO #345, January 1971.
[167] AIPO release December 1969.
[168] AIPO release December 1969.
[169] H. Erskine, 'The Polls: Opinion of the News Media', *Public Opinion Quarterly* (1970), p. 643.
[170] D. L. Altheide, *Creating Reality: How TV News Distorts Events* (Beverly Hills, California: Sage Publications, 1974), pp. 173–174. See also, Westell, *op. cit.*, p. 54; P. Wilson, 'The Nature of News', *Journalism, Communication and the Law*, (ed. by G. S. Adam) (Scarborough, Ontario: Prentice-Hall of Canada, Ltd., 1976), pp. 26, 30.

TABLE 1

REGISTERED MOTOR VEHICLES
(millions)

	TOTAL NUMBER		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	6.3	86.3	0	0
1965	6.6	90.4	4.8	4.8
1966	7.0	94.2	11.1	9.2
1967	7.4	100.0	17.5	15.9
1968	7.8	101.0	23.8	17.0
1969	8.2	104.7	30.2	21.3
1970	8.4	108.4	33.3	25.6
1971	9.0	112.9	42.9	30.8
1972	9.4	118.6	49.2	37.4
1973	10.1	125.4	60.3	45.3
1974	11.0	130.8	74.6	51.6

Sources: (53–219) *The Motor Vehicle: Part III Registrations*, 1974, p. 9, T1. *Statistical Abstract of the United States 1966*, p. 570, T819; *1970*, p. 543, T838; *1974*, p. 555, T926; *1975*, p. 571, T953.

TABLE 2

MOTOR GASOLINE

(thousand metric tons)

	PRODUCTION		CONSUMPTION	
	CANADA	USA	CANADA	USA
1964	14 252	188 850	14 229	188 990
1965	14 901	194 210	15 077	196 600
1966	15 651	205 420	16 029	205 830
1967	16 477	212 140	16 781	212 270
1968	17 383	223 850	17 911	225 830
1969	18 238	234 780	18 625	236 570
1970	19 324	244 620	19 796	247 520
1971	19 397	256 050	20 798	257 360
1972	21 712	269 983	21 984	273 596
1973	23 881	279 654	24 183	285 522
1974	25 080	272 166	24 848	279 739

	PRODUCTION/CONSUMPTION RATIO		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	1.00	1.00	0	0
1965	0.99	0.99	−1.0	−1.0
1966	0.98	1.00	−2.0	0.0
1967	0.98	1.00	−2.0	0.0
1968	0.97	0.99	−3.0	−1.0
1969	0.98	0.99	−2.0	−1.0
1970	0.98	0.99	−2.0	−1.0
1971	0.93	0.99	−7.0	−1.0
1972	0.99	0.99	−1.0	−1.0
1973	0.99	0.99	−1.0	−2.0
1974	1.01	0.97	1.0	−3.0

Sources: OECD, *Statistics of Energy 1959–1973*, Paris 1973, p. 161, T14, p. 179, T14; *1960–1974*, pp. 143, 149.

TABLE 3

WOULD YOU FAVOR OR OPPOSE THE SETTING* OF A MAXIMUM SPEED LIMIT ON HIGHWAYS OF 55 MILES PER HOUR?

	PERCENT FAVORING	
	CANADA	USA
1974	56	72
1975	65	73

* The USA question substituted "Keeping" for "setting" since the USA already had the 55 mile per hour limit.

Sources: CIPO June 1974, *Toronto Star*, October 19, 1974, p. B3; October 1975, *Toronto Star*, November 26, 1975, p. A2.
The Gallup Opinion Index, July 1974, p. 13; January 1975, p. 23.

FIGURE 1

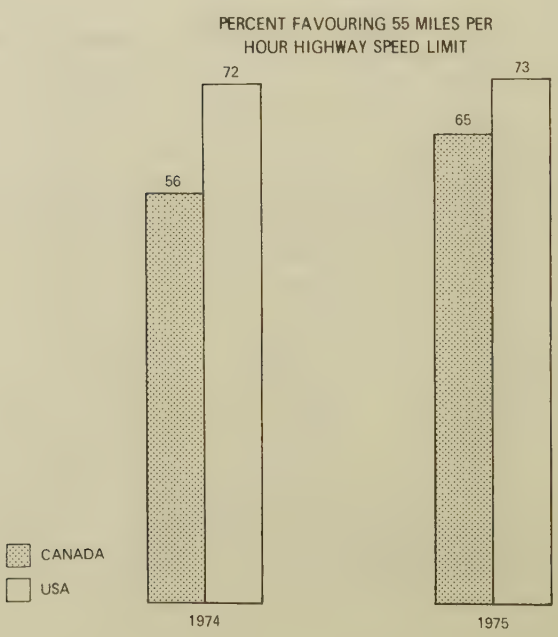

TABLE 4

PASSENGER CARS REGISTERED

	TOTAL REGISTRATIONS		PERCENT CHANGE OVER 1964	
	CANADA	USA (000's)	CANADA	USA
1964	5 037 861	71 983	0	0
1965	5 279 373	75 241	4.8	4.5
1966	5 480 724	78 354	8.8	8.9
1967	5 876 691	80 388	16.7	11.7
1968	6 159 573	83 596	22.3	16.1
1969	6 433 283	86 855	27.7	20.7
1970	6 602 196	89 230	31.1	24.0
1971	6 967 247	92 799	38.3	28.9
1972	7 407 275	96 860	47.0	34.6
1973	7 866 084	101 237	56.1	40.6
1974	8 472 224	104 900	68.2	45.7

Sources: *Statistical Abstract of the United States 1968*, p. 551, T819; *1973*, p. 547, T900; *1974*, p. 556, T928; *1978*, p. 649, T1090.
Canada Year Book 1967, p. 808; *1969*, p. 822; *1970–71*, p. 910; *1972*, p. 892; *1976–77*, p. 768, T15.12.

TABLE 5

HOUSEHOLDS WITH AUTOMOBILES

	ONE AUTO (000's)		TWO OR MORE (000's)		ONE OR MORE (000's)	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	3018	31 240	585	12 496	3602	44 304
1965	3125	32 120	622	14 016	3747	46 136
1966	3125	31 914	725	14 775	3850	46 689
1967	3200	31 906	784	15 050	3984	46 956
1968	3294	32 436	834	15 912	4128	48 348
1969	3364	32 292	882	16 767	4246	49 059
1970	3438	34 398	950	17 836	4388	52 234
1971	3437	35 805	1044	18 228	4482	54 033
1972	3590	NA	1130	NA	4720	54 675
1973	3592	NA	1292	23 137	4884	55 625
1974	3663	34 550	1402	23 152	5064	59 330

	ONE AUTO (%)		TWO OR MORE (%)		ONE OR MORE (%)	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	62	55	12	22	74	78
1965	63	55	12	24	75	79
1966	61	54	14	25	75	79
1967	61	53	15	25	76	78
1968	61	53	16	26	77	79
1969	61	52	16	27	77	79
1970	61	54	17	28	78	82
1971	60	55	18	28	78	83
1872	59	NA	19	NA	77	82
1973	57	NA	21	34	78	82
1974	56	49	22	33	78	84

Sources: (64–202) *Household Facilities and Equipment Survey 1964*, p. 23, T32; *1965*, p. 21, T31; *1966*, p. 22, T32; *1968*, p. 42, TA31, p. 25, T32; *1969*, p. 23, T32; *1970*, p. 22, T32; *1971*, p. 21, T25; *1972*, p. 19, T25; *1973*, p. 20, T25; *1974*, p. 20, T25.

Statistical Abstract of the United States 1969, p. 552, T825; *1970*, p. 546, T842; *1971*, p. 536, T852; *1974*, p. 559, T932; *1975*, p. 406, T665; *1976*, p. 424, T689; *1978*, p. 656, T1104.

CHART 1

PERCENT OF ALL HOUSEHOLDS
WITH ONE OR MORE AUTOMOBILES

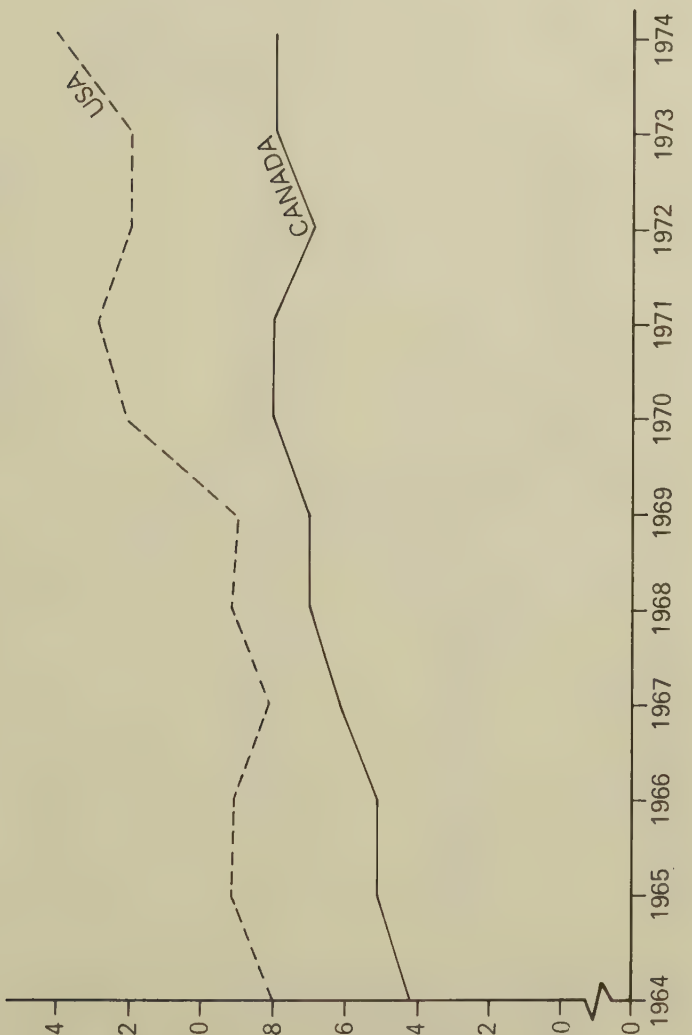

TABLE 6

DEATH BY MOTOR VEHICLE ACCIDENTS

	TOTAL NUMBER	
	CANADA	USA
1964	4862	46 930
1965	5049	49 163
1966	5410	53 041
1967	5522	52 924
1968	5488	54 862
1969	5696	56 000
1970	5312	54 800
1971	5690	54 700
1972	6308	56 600
1973	6522	55 567
1974	6325	46 402

	RATE PER 100 000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	25.2	24.5	0	0
1965	25.7	25.3	1.9	3.2
1966	27.0	27.0	7.1	10.2
1967	27.1	26.6	7.5	8.5
1968	26.5	27.3	5.1	11.4
1969	27.0	27.6	7.1	12.6
1970	24.9	26.7	−1.1	8.9
1971	26.4	26.4	4.7	7.7
1972	28.9	27.1	14.6	10.6
1973	29.5	26.5	17.0	8.1
1974	28.2	22.0	11.9	−10.2

Sources: For US see "Death by Major Cardiovascular Disease" table, Volume 1, p. 187 plus *Statistical Abstract of the United States 1978*, p. 78, T112; National Highway Traffic Safety Administration.
For Canada See "Death by Malignant Neoplasms" table, Volume I, p. 188 plus *Canada Year Book 1976–77*, p. 203, T4.41.

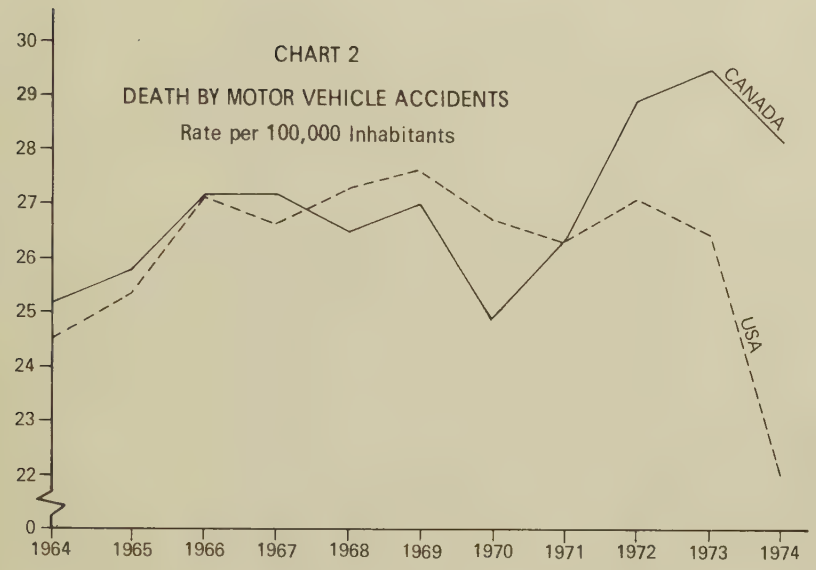
CHART 2
DEATH BY MOTOR VEHICLE ACCIDENTS
Rate per 100,000 Inhabitants
CANADA
USA
30
29
28
27
26
25
24
23
22
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

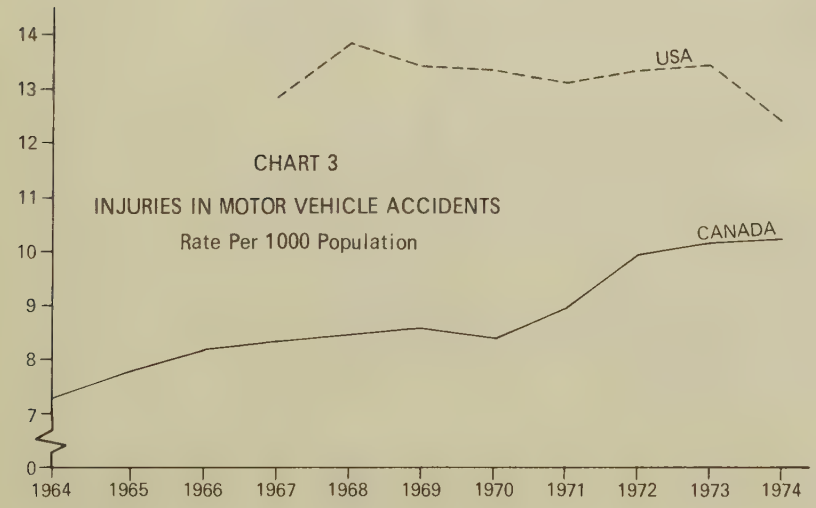
CHART 3
INJURIES IN MOTOR VEHICLE ACCIDENTS
Rate Per 1000 Population
USA
CANADA
14
13
12
11
10
9
8
7
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

TABLE 7

INJURIES IN MOTOR VEHICLE ACCIDENTS

	RATE PER 1000 POPULATION		PERCENT CHANGE OVER 1967	
	CANADA	USA	CANADA	USA
1964	7.24	NA	–	–
1965	7.67	NA	–	–
1966	8.05	NA	–	–
1967	8.25	12.71	0	0
1968	8.40	13.69	1.8	7.7
1969	8.61	13.46	4.3	5.9
1970	8.38	13.41	1.5	5.5
1971	8.93	13.05	8.2	2.6
1972	9.88	13.42	19.7	5.5
1973	10.13	13.49	22.8	6.1
1974	10.23	12.50	24.0	–1.7

Sources: US Department of Transportation, *Fatal and Injury Accident Rates 1973*, p. 14, TVPD–1; *1974*, p. 14, TVPD–1.
(53–206) *Motor Vehicle Traffic Accidents 1965*, p. 5; *1968*, p. 5; *1969*, p. 6; *1970*, p. 5; *1971*, p. 6; *1972*, p. 6; *1973*, p. 6; *1974*, p. 7.

TABLE 8

CAUSAL FACTORS INVOLVED IN 285 TRAFFIC ACCIDENTS IN CANADA, 1971 TO 1975

Factors	PHASES	PRE-CRASH	CRASH	POST-CRASH
		1	2	3
		541 Causal Factors (64%)	382 Causal Factors (62%)	52 Causal Factors (40%)
	Human	18% Inattention 17% Excessive Speed 14% Alcohol involved 14% Improper Action 13% Inexperience 6% Perception or Reaction Failure 5% Unfamiliarity (Vehicle) 3% Acute Physical Breakdown 3% Miscellaneous 4% Proper Evasion*	73% Failed to use Restraint System 2% No Restraint System 2% Restraint improperly Adjusted 2% Ejection 19% Restraint System Used* 1% Restraint System Partially Used (lap only)* 1% Bracing*	23% Occupant Extrication Problems 12% Inadequate Medical Treatment (on scene) 12% Irrational or Panic 53% Prompt Medical Aid*
		4	5	6
		82 Causal Factors (10%)	195 Causal Factors (32%)	72 Causal Factors (55%)
	Vehicle	41% Improper Tire Mix or Tire Pressure 22% Alterations 18% Poor Maintenance 11% Headlight and Taillight Obstructions (Dirty lenses) 4% Steering Problem 4% Braking Problem	17% Doors Opened 10% Failed Components 8% Seat Failure 6% Doors Jammed 5% Miscellaneous 3% No Energy Absorbing Device 30% Interior (Occupant Protection)* 21% Energy Absorbing Device*	35% Occupants Trapped 35% Fuel Leakage 30% Fire

TABLE 8 (continued)

Factors		7	8	9
		221 Causal Factors (26%)	36 Causal Factors (6%)	6 Causal Factors (5%)
	Environment	35% Poor Road Design 26% View Obstructed 21% Wet or Icy Roadway 10% Poor Maintenance 1% Reduced Visibility 1% Signs Inadequate 6% Miscellaneous	25% Utility Poles or Trees 17% Poor Guardrail Performance 17% Lack of Guardrails 17% Non-Frangible Traffic Sign Poles 16% Other Fixed Objects (Piers, Bridge, Supports, etc.) 8% Depressed Catch Basin	100% Other Accidents due to Traffic Tie Up
	TOTALS	844 Causal Factors	613 Causal Factors	130 Causal Factors

* Positive factors.

Source: Road and Vehicle Traffic Safety Branch, Ministry of Transport, *Road Safety Annual Report 1975* (Ottawa: Information Canada, 1975), p. J–1.

TABLE 9

WHAT IS THE CHIEF REASON FOR AUTO ACCIDENTS IN YOUR OPINION?

1966

	PERCENT ANSWERING	
	CANADA	USA*
Careless Drivers	42	60
Speeding	26	31
Drinking	32	21

* The column does not add up to 100% because respondents were allowed to give more than one answer.

Sources: CIPO #319 June 1966.
AIPO #727 April 1966.

FIGURE 2

PERCENT OF PEOPLE ASSERTING IN 1966 THAT THE CHIEF REASON FOR AUTO ACCIDENTS IS:

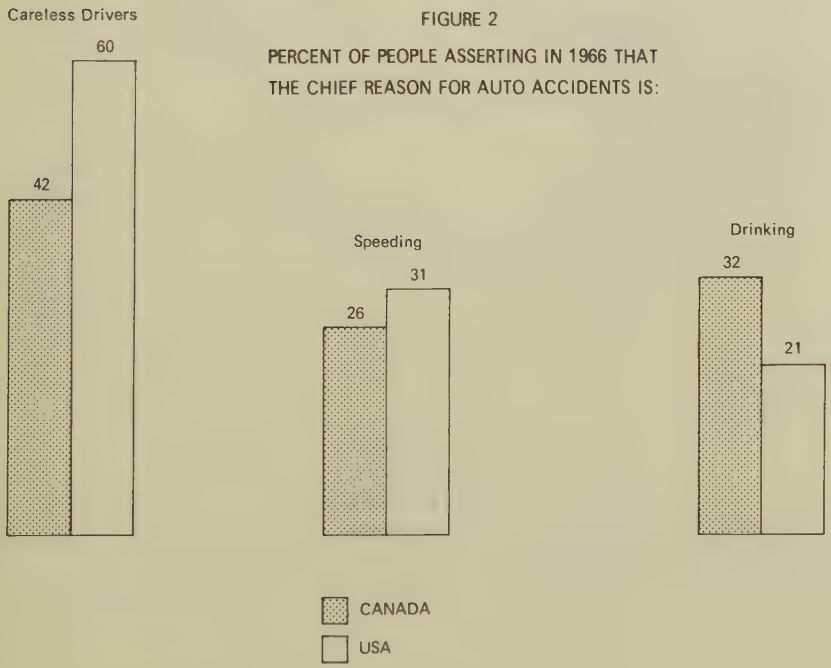

TABLE 10

WHAT, IN YOUR OPINION, SHOULD BE DONE TO REDUCE THE NUMBER AND SEVERITY OF AUTO ACCIDENTS?

1966

PERCENT ANSWERING	CANADA	USA
Stricter law enforcement	27	16
Stiffer penalties for offenders		11
Better driver education	17	9
Stricter exams to get license		8
Cut down power of cars	7	9
Increase safety features		9
Raise minimum age for licenses	7	8
Re-testing of drivers	4	7
More careful driving	4	7
Reduce speed limits	6	7
Stop drinking and driving	NA	6

Sources: AIPO #727 April 1966; CIPO August 31, 1966.

TABLE 11

SELECTED RAILROAD STATISTICS

ITEM	CANADA	USA
1968–70		
Rail revenue as % GNP	2.3	1.2
Gross ton-miles[a] per year per capita (1000)	9.1	8.2
Freight ton-miles per year per capita (1000)	4.6	3.7
Running track (miles per 1000 population)	2	1.16
Running track traffic density (million gross tons per year)	4.5	7
1970		
Mean net load per train (tons)	1650	1780
Mean train run (miles)	533	516
Mean wagon capacity (tons)	60	67
Net load/Gross weight (%)	52	46
Mean load/Mean capacity (%)	80	82
Rail revenue as % capital investment	23	35
Passenger revenue as % total	6	5
Daily train frequency ratios[b]		
All trains	5.5	6.8
Passenger trains	1.5	1.2
Freight trains	4.0	5.6
Employees per 10^5 train-miles	141	108
Employees per 10^6 units of traffic[c]	0.8	0.5
1971		
Gains or losses as % of revenue		
Canadian National Railway (loss)	2.2	
Canadian Pacific Railway (gain)	3.8	
USA Railroads (gain)		5.5
AMTRAK 1972–1974 (loss)		93

[a] A ton-mile equals the result of multiplying tons by miles.

[b] The ratio of train-miles per day to the total network route miles.

[c] A unit of traffic equals the sum of passenger-miles and freight ton-miles.

Source: J. Lukasiewicz, *The Railway Game: A Study in Socio-Technological Obsolescence* (Toronto: McClelland and Stewart Ltd., 1976), p. 51, Table 8.1, p. 59, Table 8.3 and 8.4, p. 60, Table 8.5 and 8.6, p. 61, Table 8.7, p. 168, Table 15.1.

TABLE 12

TRANSPORTATION PROPULSION ENERGY EFFICIENCY BY CARRIER TYPE

PASSENGER		FREIGHT	
TRANSPORT TYPE	PASSENGER MILES PER GALLON	TRANSPORT TYPE	CARGO TON MILES PER GALLON
Large jet plane (Boeing 747)	22	One-half of a Boeing 707 (160 tons, 30 000 hp)	8.3
Small jet plane (Boeing 704)	21	One-fourth of a Boeing 747 (360 tons, 60 000 hp)	11.4
Automobile (sedan)	32	Sixty 250-hp, 40-ton trucks	50.0
Cross-country train[a]	80	Fast 3000-ton, 40-car freight train	97.0
Commuter train[b]	100	Three 5000-ton, 100-car freight trains	250.0
Large bus (40 foot)	125	Inland barge tow, 60 000 gross ton	220.0
Small bus (35 foot)	126	Large pipeline, 100 miles, two pumps	500.0
Suburban train (two-deck)[c]	200	100 000-ton supertanker, 15 knots	930.0

[a] One 150-ton locomotive and four 70-seat coaches plus diner lounge and baggage coach.

[b] Ten 65-ton cars and two 150-ton 200-hp diesel locomotives.

[c] A ten-car gallery-car commuter train, 160 seats per car.

Source: G. A. Lincoln, 'Energy Conservation', *Science* (1973), p. 157, Table 1.

TABLE 13

TRANSPORTATION FATALITIES BY CARRIER TYPE, 1976

CARRIER TYPE	CANADA	PERCENT	USA	PERCENT
Vehicle occupants	3882	66		
Pedestrians	835	14		
Motorcycles	285	5		
Bicycles	150	3		
Highway grade crossings	108	2		
Total road	5260	90	47276	93
Scheduled flights	110	2		
Nonscheduled flights	50	1		
Total air	160	3	1445	3
Pleasure boats	324	5		
Carriers	46	1		
Total marine	370	6	1371	3
Total railroad	36	1	552	1
Total fatalities	5826	100*	50644	100

* The totals for road, air, marine and railroad *and* the subdivision figures for each carrier type separately sum to 100%.

Source: Road and Motor Vehicle Traffic Safety Branch, Department of Transport, *Road Safety Annual Report 1978* (Ottawa: Minister of Supply and Services, 1978), p. 1, Figure 1.
U.S. Department of Commerce, *Statistical Abstract of the United States 1978* (Washington: U.S. Government Printing Office, 1978), p. 78, Table 112.

TABLE 14

PASSENGER FATALITIES IN INTERCITY TRANSPORTATION, RATE PER 100 MILLION PASSENGER MILES, UNITED STATES, 1940–1975.

YEAR	DOMESTIC SCHEDULED AIR CARRIERS[a]	RAIL	BUS	AUTO
1940	30.00	3.40	n/a	n/a
1945	22.00	1.60	n/a	n/a
1950	1.14	0.58	0.18	2.9
1955	0.75	0.07	0.18	2.7
1960	0.93	0.16	0.13	2.2
1965	0.38	0.07	0.16	2.4
1970	0.00	0.09	0.19	2.1
1971	0.16	0.53	0.19	2.1
1972	0.13	0.56	0.17	1.9
1973	0.10	0.07	0.17	1.7
1974	0.13	0.08	0.06	1.3
1975	0.09	0.08	0.02	1.2

n/a = not available.

[a] = The fatality rate of general aviation is quite high, reaching 42.06 per 100 million plane miles in 1974.

Source: R. C. Lieb, *Transportation: The Domestic System* (Restin, Virginia: Reston Pub. Co., 1978), p, 122, Table 6–6.

TABLE 15

INTERCITY FREIGHT MARKET SHARE BY MODE, UNITED STATES

(percent of freight ton miles)[a]

	1940	1950	1960	1970	1975[c]
Railroads	61.3	56.2	44.1	39.7	36.8
Oil Pipelines	9.5	12.1	17.4	22.3	24.2
Motor Carriage	10.0	16.3	21.8	21.3	21.3
Water[b]	19.1	15.4	16.7	16.6	17.1
Air		0.03	0.07	0.18	0.19

a = Includes mail and express.

b = Includes inland and Great Lakes traffic.

c = Percentages do not total 100% due to rounding.

Source: R. C. Lieb, *Transportation: The Domestic System* (Restin, Virginia: Reston Pub. Co., 1978), p. 9, Table 1–2.

TABLE 16

INTERCITY COMMERCIAL PASSENGER MARKET SHARE BY MODE, UNITED STATES

(percent of passenger miles)

	1940	1950	1960	1970	1975
Air	3.2	14.1	42.1	73.0	77.5
Bus	27.2	34.6	25.6	16.9	14.5
Rail	66.2	49.5	28.7	7.8	5.7
Water	3.4	1.8	3.6	3.3	2.3

Source: R. C. Lieb, *Transportation: The Domestic System* (Restin, Virginia: Reston Pub. Co., 1978), p. 10, Table 1–3.

TABLE 17

NET INCOME AS A PERCENT OF STOCKHOLDERS' EQUITY FOR ICC[a] AND CAB[b] REGULATED CARRIERS, UNITED STATES 1960–69

YEAR	CLASS 1[c] LINE-HAUL RAILROAD	CLASS 1[d] INTERCITY MOTOR CARRIERS PROPERTY	CLASS 1[d] INTERCITY MOTOR CARRIERS PASSENGER	DOMESTIC AIR CARRIERS	OIL PIPELINE COMPANIES	CLASS A AND B[e] WATER CARRIERS	MANUFACTURING CORPORATIONS
1960	2.57	4.93	10.97	0.12	15.71	5.73	9.2
1961	2.21	10.20	11.26	–4.63	16.27	6.14	8.8
1962	3.25	12.36	10.95	2.64	17.57	7.65	9.8
1963	3.65	12.06	12.32	2.19	15.96	9.47	10.2
1964	3.96	13.63	12.07	16.50	15.97	13.40	11.6
1965	4.59	15.72	18.17	20.99	16.25	11.92	13.0
1966	4.97	14.48	15.33	17.18	16.50	12.45	13.4
1967	1.79	9.23	11.56	12.07	17.66	12.17	11.7
1968	3.14	12.87	14.39	3.79	16.19	10.96	12.1
1969	2.61	8.84	15.10	0.54	15.55	8.49	11.5
Average	3.27	11.33	13.31	7.14	16.36	9.74	11.1

a = Interstate Commerce Commission.

b = Civil Aeronautics Board.

c = Railroads with annual gross operating revenues in excess of $10 million.

d = Motor carriers with annual gross operating revenues in excess of $3 million.

e = Class A water carriers have annual gross operating revenues in excess of $500 000; Class B, between $ 100 000 and $500 000.

Source: U.S. Department of Transportation, *1972 National Transportation Report: Present Status – Future Alternatives* (Washington: U.S. Government Printing Office, 1972), p. 77, Table III–14.

TABLE 18

OVERSEAS TRAVEL

	TOTAL TRAVELLERS (thousands)	
	CANADA	USA
1964	323	2220
1965	456	2623
1966	503	2975
1967	522	3425
1968	638	3885
1969	852	4623
1970	1099	5260
1971	1197	5667
1972	1144+	6790
1973	1360	6933
1974	1434	6467

	RATE PER 100 000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	1674	1157	0	0
1965	2364	1350	41.2	16.6
1966	2512	1514	50.0	30.8
1967	2558	1724	49.8	49.0
1968	3076	1936	83.7	67.3
1969	4046	2281	141.6	97.1
1970	5140	2567	207.0	121.8
1971	5549	2737	231.4	136.5
1972	5240	3251	213.0	180.9
1973	6157	3304	267.8	185.5
1974	6389	3052	281.7	163.8

+ Beginning 1972 crews were not counted.

Sources: *Statistical Abstract of the United States 1967*, p. 216, T311; *1971*, p. 205, T324; *1974*, p. 215, T355; *1978*, p. 251, T412.
(66–201) *Travel Between Canada and Other Countries 1964*, p. 43, T26.
(66–202) *Travel, Tourism and Outdoor Recreation 1972*, p. 43, T3.4; *1973–74*, p. 51, T3.2; *1975 and 1976*, p. 65, T2.17.

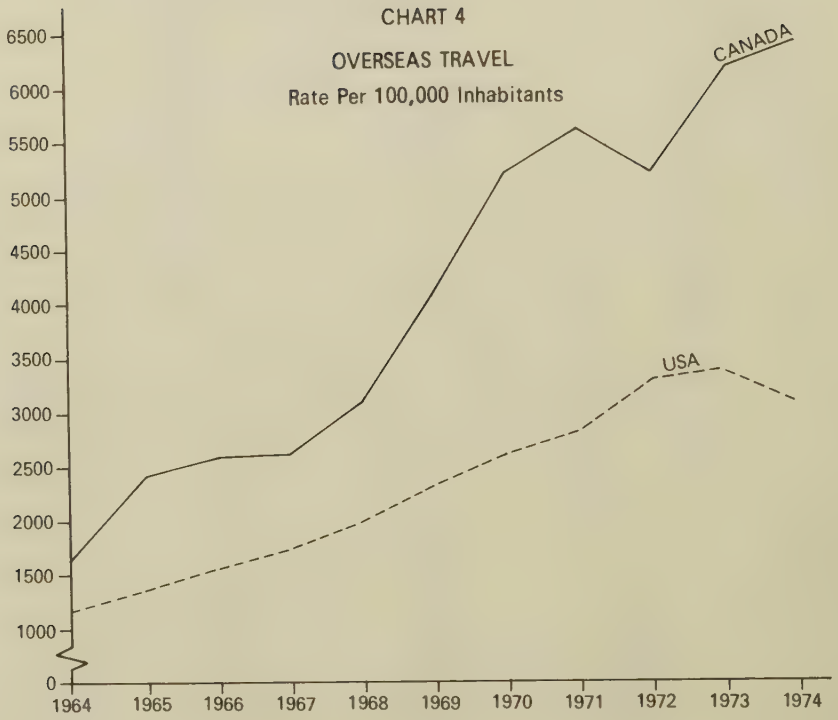
CHART 4
OVERSEAS TRAVEL
Rate Per 100,000 Inhabitants
CANADA
USA
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

TABLE 19

NUMBER OF NIGHTS SPENT ABROAD BY TRAVELLERS

	TOTAL NIGHTS (thousands)	
	CANADA (in other countries)	USA (in Europe)
1964	13 228	52 493[e]
1965	15 719	54 795
1966	12 296	58 090
1967	12 893	59 400
1968	16 295	56 400
1969	21 814	66 265
1970	29 201	75 141
1971	30 016	78 780
1972	30 409	98 982
1973	32 603	89 280
1974	35 321	74 832

	RATE PER 1000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	686	274	0	0
1965	800	281	16.6	2.5
1966	614	295	–10.4	7.6
1967	633	298	–7.7	8.7
1968	787	280	14.7	2.1
1969	1039	326	51.4	18.9
1970	1371	365	99.8	33.2
1971	1390	380	102.6	36.4
1972	1392	474	102.9	72.9
1973	1476	424	115.2	54.8
1974	1574	353	129.5	28.8

[e] = estimated.

Sources: (66–201) *Travel Between Canada and Other Countries 1964*, p. 57, T40.
(66–202) *Travel, Tourism and Outdoor Recreation 1972*, p. 60, T5.1; *1973–74*, p. 57, T3.10; *1974 and 1975*, p. 79, T2.22; *1975 and 1976*, p. 65, T2.17.
OECD, *Tourism Policy and International Tourism in OECD Member Countries 1976*, Paris, p. 43, T1.

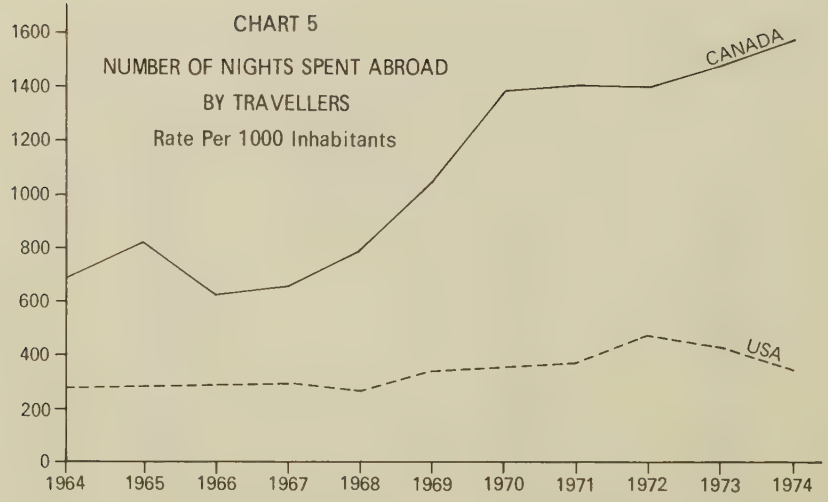
CHART 5
NUMBER OF NIGHTS SPENT ABROAD
BY TRAVELLERS
Rate Per 1000 Inhabitants
CANADA
USA
1600
1400
1200
1000
800
600
400
200
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

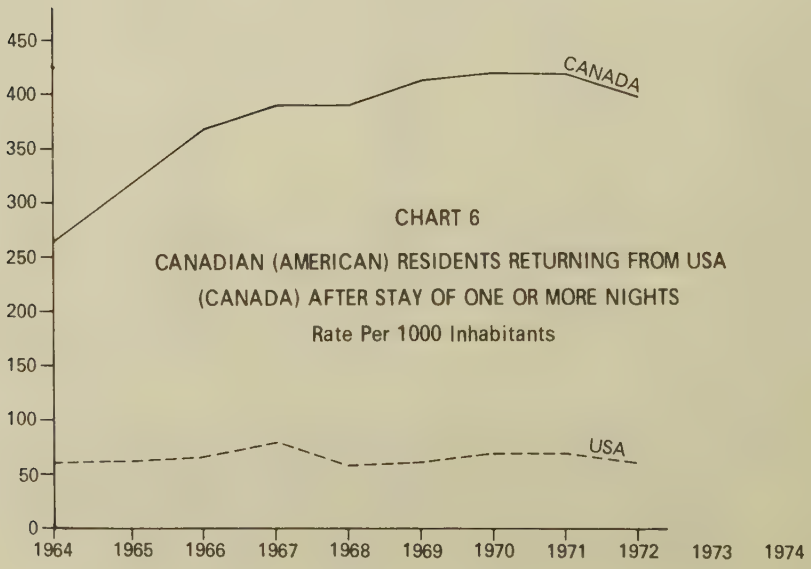
CANADA
CHART 6
CANADIAN (AMERICAN) RESIDENTS RETURNING FROM USA
(CANADA) AFTER STAY OF ONE OR MORE NIGHTS
Rate Per 1000 Inhabitants
USA
450
400
350
300
250
200
150
100
50
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

TABLE 20

CANADIAN (AMERICAN) RESIDENTS RETURNING FROM USA (CANADA) AFTER STAY OF ONE OR MORE NIGHTS

	TOTAL RESIDENTS (000's)	
	CANADA*	USA
1964	5148	11 189
1965	6242	11 888
1966	7257	12 818
1967	7791	15 464
1968	7898	11 708
1969	8611	12 312
1970	8986	13 648
1971	9072	14 337
1972	8724+	13 067

	RATE PER 1000 INHABITANTS		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	267	58	0	0
1965	317	61	18.7	5.1
1966	362	65	35.5	12.0
1967	381	77	42.6	32.7
1968	380	58	42.3	0.0
1969	408	60	52.8	3.4
1970	420	66	57.3	13.7
1971	420	69	57.3	18.9
1972	399	62	49.4	6.8

* Canadian residents returning.
\+ Crews included prior to 1972.

Sources: (66–201) *Travel Between Canada and Other Countries 1964*, p. 21, T7; *1965*, p. 19, T9; *1971*, p. 56, T8; *1972*, p. 45, T1;
(66–202) *Travel, Tourism and Outdoor Recreation 1972*, p. 26, T2.1.

TABLE 21

NUMBER OF NIGHTS SPENT IN CANADA (USA) BY AMERICAN (CANADIAN) RESIDENT TRAVELLERS

	TOTAL NUMBER (thousands)	
	CANADA*	USA
1964	43 286	42 577
1965	45 322	45 160
1966	49 452	48 237
1967	51 505	72 526
1968	49 757	54 934
1969	60 277	56 491
1970	63 801	63 671
1971	62 597	66 860
1972	66 944	71 117

	RATE PER 1000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	2244	222	0	0
1965	2307	232	2.8	4.5
1966	2470	245	10.0	10.3
1967	2527	364	12.6	63.9
1968	2400	274	6.9	23.4
1969	2866	279	27.7	25.6
1970	2992	311	33.3	40.0
1971	2898	323	29.1	45.4
1972	2064	278+	36.5	25.2

* Canadians spending time in USA.
\+ Excludes nights spent by crews.

Sources: (66–201) *Travel Between Canada and Other Countries 1964*, p. 57, T40. (66–202) *Travel, Tourism and Outdoor Recreation 1972*, p. 60, T5.1; *1973–74*, p. 57, T3.10.

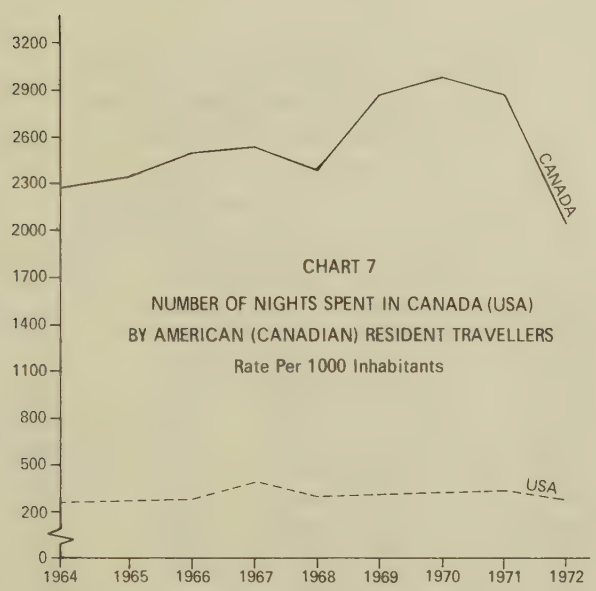

CHART 7

NUMBER OF NIGHTS SPENT IN CANADA (USA)
BY AMERICAN (CANADIAN) RESIDENT TRAVELLERS
Rate Per 1000 Inhabitants

TABLE 22

CANADIANS RETURNING FROM THE U.S. BY PURPOSE OF TRIP, 1961–70

YEAR	BUSINESS	FORMAL STUDY	SHOPPING	RECREATION HOLIDAY	VISITING FRIENDS OR RELATIVES	HEALTH	OTHER
1961	10.3%	0.7%	5.9%	48.6%	32.1%	1.2%	1.2%
1962	11.4%	0.5%	2.4%	49.3%	32.1%	2.5%	1.8%
1963	11.9%	0.5%	1.4%	47.4%	34.2%	3.1%	1.5%
1964	12.2%	0.6%	2.2%	48.5%	32.0%	3.2%	1.3%
1965	11.7%	0.8%	2.0%	51.6%	30.1%	2.6%	1.2%
1966	8.4%	0.6%	1.5%	59.6%	24.8%	1.4%	3.7%*
1967	7.9%	0.3%	5.1%	53.3%	26.6%	2.0%	4.8%*
1968	7.3%	—	4.6%	54.2%	26.8%	—	7.1%*
1969	8.7%	—	3.7%	58.7%	25.5%	—	3.4%*
1970	9.2%	—	3.1%	55.9%	26.9%	—	5.9%

* Includes Transit through the U.S.

Source: Office of Tourism, Department of Industry Trade and Commerce, *The Canadian Tourism Facts Book 1972* (Ottawa: Minister of Supply and Services, 1972), p. 220, Table E72.

TABLE 23

PAYMENTS FOR INTERNATIONAL TOURISM
(constant 1964 US dollars)

	TOTAL PAYMENTS (millions)	
	CANADA	USA
1964	660	2211
1965	715	2361
1966	787	2505
1967	758	2918
1968	800	2654
1969	981	2826
1970	1082	3162
1971	1088	3270
1972	1086	3634
1973	1216	3774
1974	1282	3548

	PER CAPITA PAYMENTS (dollars)		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	34.2	11.5	0	0
1965	36.4	12.1	6.4	5.2
1966	39.4	12.7	15.2	10.4
1967	37.2	14.6	8.7	26.9
1968	39.6	13.2	15.7	14.7
1969	47.7	13.9	39.4	20.8
1970	52.0	15.4	52.0	33.9
1971	50.3	17.4	47.0	51.3
1972	49.5	17.8	44.7	54.7
1973	55.0	17.8	60.8	54.7
1974	57.1	16.7	67.0	45.2

Sources: *Statistical Abstract of the United States 1967*, p. 216, T311; *1971*, p. 205, T324; *1974*, p. 215, T355; *1975*, p. 219, T366.
(66–201) *Travel Between Canada and Other Countries 1965*, p. 58, T1.
(66–202) *Travel, Tourism and Outdoor Recreation 1972*, pp. 65–6, T5.5 abd T5.6; *1973–74*, p. 59, T3.12, p. 61, T3.13; *1974 and 1975*, p. 120, T5.6.

TABLE 24

PAYMENTS FOR INTERNATIONAL TOURISM

(current dollars)

	TOTAL PAYMENTS (millions)		
	CANADA	CANADA IN US DOLLARS	USA
1964	712	660	2211
1965	796	738	2438
1966	900	835	2657
1967	895	830	3195
1968	982	911	3022
1969	1261	1171	3373
1970	1422	1362	3980
1971	1448	1434	4311
1972	1464	1478	4944
1973	1742	1742	5407
1974	1986	2031	5622

Sources: See Table 23.

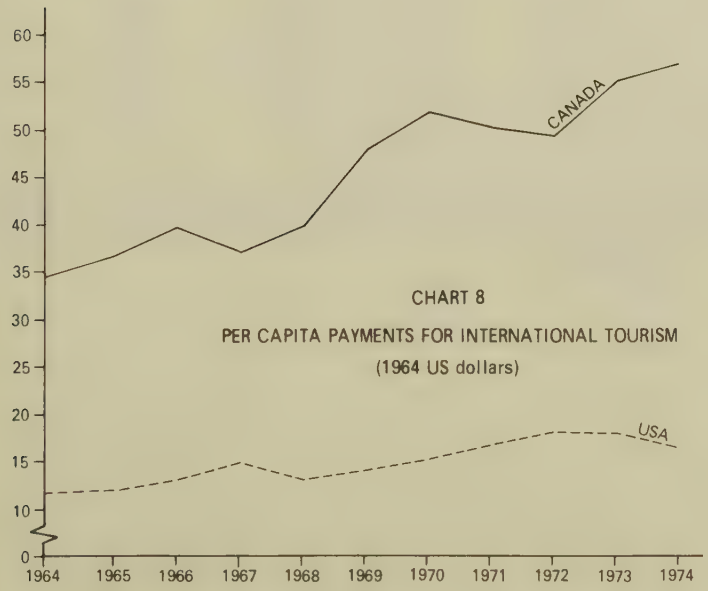

CHART 8

PER CAPITA PAYMENTS FOR INTERNATIONAL TOURISM

(1964 US dollars)

TABLE 25

CANADA'S TRAVEL ACCOUNTS WITH OVERSEAS COUNTRIES 1959–1970
(CURRENT CANADIAN MILLIONS)

YEAR	RECEIPTS		EXPENDITURES		BALANCE
	AMOUNT	% CHANGE	AMOUNT	% CHANGE	
1959	$ 40	—	$150	—	$–110
1960	$ 45	12.5%	$165	10.0%	$–120
1961	$ 47	4.4%	$183	10.9%	$–136
1962	$ 50	6.4%	$186	1.6%	$–136
1963	$ 60	20.0%	$197	5.9%	$–137
1964	$ 72	20.0%	$231	17.3%	$–159
1965	$ 87	20.8%	$248	7.4%	$–161
1966	$110	26.4%	$272	9.7%	$–162
1967	$154	40.0%	$268	–1.5%	$–114
1968	$ 87	–43.5%	$298	11.2%	$–211
1969	$105	20.7%	$399	33.9%	$–294
1970	$152	44.8%	$524	31.3%	$–372

Source: Office of Tourism, Department of Industry Trade and Commerce, *The Canadian Tourism Facts Book 1972* (Ottawa: Minister of Supply and Services, 1972), p. 226, Table E77.

TABLE 26

CANADA'S TRAVEL ACCOUNTS WITH THE UNITED STATES 1959–1970
(CURRENT CANADIAN MILLIONS)

YEAR	RECEIPTS		EXPENDITURES		BALANCE
	AMOUNT	% CHANGE	AMOUNT	% CHANGE	
1959	$ 351	–	$448	–	$–97
1960	$ 375	6.8%	$462	3.1%	$–87
1961	$ 435	16.0%	$459	–0.1%	$–24
1962	$ 512	17.7%	$419	–8.7%	$ 83
1963	$ 549	7.2%	$380	–9.3%	$ 161
1964	$ 590	7.5%	$481	26.6%	$ 109
1965	$ 660	11.9%	$531	10.4%	$ 129
1966	$ 730	10.6%	$628	18.3%	$ 102
1967	$1164	59.9%	$627	0.0%	$ 537
1968	$ 891	–23.5%	$710	13.2%	$ 181
1969	$ 969	8.8%	$893	25.8%	$ 76
1970	$1082	11.7%	$936	4.8%	$ 146

Source: Office of Tourism, Department of Industry Trade and Commerce, *The Canadian Tourism Facts Book 1972* (Ottawa: Minister of Supply and Services, 1972), p. 182, Table E 36.

TABLE 27

THE U.S. TRAVEL ACCOUNT: 1960 TO 1971*
(MILLIONS OF CURRENT U.S. DOLLARS)

COUNTRY		1960	1971	% CHANGE
	Receipts	29	67	131
United Kingdom	Expenditures	114	324	184
	Balance	–85	–257	203
	Receipts	59	300	408
Western Europe	Expenditures	593	1049	77
	Balance	–484	–749	55
	Receipts	460	927	102
Canada	Expenditures	380	1127	197
	Balance	89	–200	–
	Receipts	226	565	150
Mexico	Expenditures	383	832	117
	Balance	–157	–267	70
	Receipts	86	325	278
Other West. Hem.	Expenditures	82	500	510
	Balance	4	–170	–
	Receipts	12	134	1117
Japan	Expenditures	36	88	144
	Balance	–24	46	–
	Receipts	38	139	266
All other	Expenditures	212	374	76
	Balance	–174	–235	35
	Receipts	919	2477	170
Total Account	Expenditures	1750	4294	145
	Balance	–831	–1837	121

* Excludes international fares. Receipts are all payments made in the U.S. by citizens of foreign countries. Expenditures are all payments made by Americans in foreign countries. A minus balance is a U.S. travel deficit.

Source: National Tourism Resources Review Commission, *International Visitors* ("Destination USA, Volume 3"), (Washington: U.S. Government Printing Office, 1973), p. 8, Table 9.

TABLE 28

HOUSEHOLDS WITH ONE OR MORE TELEPHONES

	TOTAL NUMBER ('000)		AS % OF ALL HOUSEHOLDS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	4293	46 477	88	83	0	0
1965	4471	48 663	89	85	1.1	2.4
1966	4634	49 959	90	86	2.2	3.6
1967	4827	51 195	92	87	4.5	4.8
1968	5002	53 795	93	89	5.6	7.2
1969	5177	55 625	94	90	6.8	8.4
1970	5304	57 215	94	91	6.8	9.6
1971	5445	58 580	94	91	6.8	9.6
1972	5778	61 342	95	92	7.9	10.8
1973	5955	64 156	95	94	7.9	13.2
1974	6223	66 552	96	94	9.0	13.2

Sources: (64–202) *Household Facilities and Equipment Survey 1964*, p. 20, T26; *1965*, p. 19, T27; *1966*, p. 19, T26; *1968*, p. 40, TA26, p. 22, T26; *1969*, p. 20, T26; *1970*, p. 19, T26; *1971*, p. 22, T27; *1972*, p. 20, T27; *1973*, p. 21, T27; *1974*, p. 21, T27.
Statistical Abstract of the United States 1969, p. 495, T727; *1970*, p. 491, T749, *1971*, p. 482, T757; *1974*, p. 500, T826; *1978*, p. 589, T972.

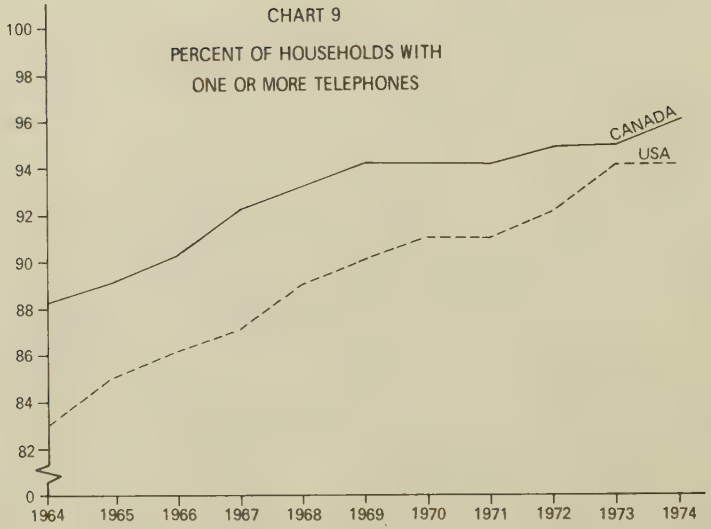
CHART 9
PERCENT OF HOUSEHOLDS WITH
ONE OR MORE TELEPHONES
CANADA
USA
100
98
96
94
92
90
88
86
84
82
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

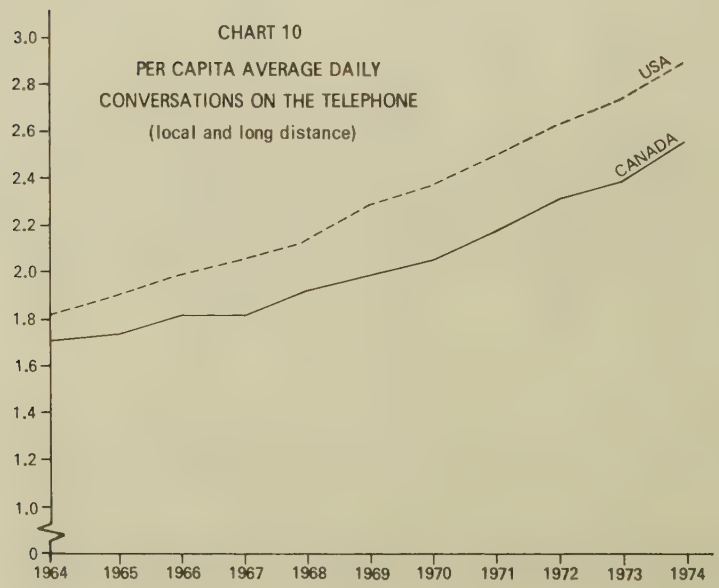
CHART 10
PER CAPITA AVERAGE DAILY
CONVERSATIONS ON THE TELEPHONE
(local and long distance)
USA
CANADA
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974

TABLE 29

TELEPHONE CALLS

(local and long distance)

	TOTAL NUMBER (000's)		AVERAGE DAILY CONVERSATIONS	
	CANADA	USA	CANADA	USA
1964	11 939 352	126 290 000	32 710 517	346 000
1965	12 439 857	133 955 000	34 082 339	367 000
1966	13 169 503	141 985 000	36 080 821	389 000
1967	13 410 529	148 555 000	36 741 216	407 000
1968	14 381 608	155 490 000	39 402 032	426 000
1969	15 030 951	168 265 000	41 180 841	461 000
1970	15 895 244	177 390 000	43 548 882	486 000
1971	16 934 819	188 705 000	46 396 408	517 000
1972	18 348 907	199 290 000	50 270 969	546 000
1973	19 054 890	210 240 000	52 205 419	576 000
1974	20 701 006	223 745 000	56 714 830	613 000

	PER CAPITA AVERAGE DAILY CONVERSATIONS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	1.70	1.80	0	0
1965	1.73	1.88	1.7	4.4
1966	1.80	1.97	5.8	9.4
1967	1.80	2.04	5.8	13.3
1968	1.90	2.12	11.7	17.7
1969	1.96	2.27	15.2	26.1
1970	2.04	2.37	20.0	31.6
1971	2.15	2.49	26.4	38.3
1972	2.30	2.61	35.2	45.0
1973	2.36	2.74	38.8	52.0
1974	2.53	2.89	48.8	60.6

Source: See "Local Telephone Calls" table.

TABLE 30

LOCAL TELEPHONE CALLS

(thousands)

	TOTAL NUMBER		AVERAGE DAILY CONVERSATIONS	
	CANADA	USA	CANADA	USA
1964	11 658 113	120 450 000	31 940	330 000
1965	12 138 243	127 750 000	33 256	350 000
1966	12 846 178	135 415 000	35 195	371 000
1967	13 053 115	140 890 000	35 762	386 000
1968	13 993 601	147 460 000	38 339	404 000
1969	14 596 659	159 140 000	39 991	436 000
1970	15 436 847	167 535 000	42 293	459 000
1971	16 439 365	178 120 000	45 039	488 000
1972	17 776 963	187 245 000	48 704	513 000
1973	18 396 642	196 735 000	50 402	539 000
1974	19 936 758	209 510 000	54 621	574 000

	PER CAPITA AVERAGE DAILY CONVERSATIONS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	1.66	1.72	0	0
1965	1.69	1.80	1.8	4.6
1966	1.76	1.89	6.0	9.8
1967	1.76	1.94	6.0	12.7
1968	1.85	2.01	11.4	16.8
1969	1.90	2.15	14.4	25.0
1970	1.99	2.24	19.8	30.2
1971	2.09	2.36	25.9	37.2
1972	2.23	2.46	34.3	43.0
1973	2.28	2.57	37.3	49.4
1974	2.43	2.71	46.4	57.6

Sources: *Statistical Abstract of the United States 1969*, p. 495, T727; *1970*, p. 491, T749; *1971*, p. 482, T757; *1974*, p. 500, T826; *1978*, p. 589, T972. (56–203) *Telephone Statistics 1973*, p. 12, T1; *1976*, p. 16, T1.

TABLE 31

LONG DISTANCE TELEPHONE CALLS

	TOTAL NUMBER ('000)		AVERAGE DAILY CONVERSATIONS	
	CANADA	USA	CANADA	USA
1964	281 239	5 840 000	770 517	16 000 000
1965	301 614	6 205 000	826 339	17 000 000
1966	323 325	6 570 000	885 821	18 000 000
1967	357 414	7 665 000	979 216	21 000 000
1968	388 007	8 030 000	1 063 032	22 000 000
1969	434 292	9 125 000	1 189 841	25 000 000
1970	458 397	9 855 000	1 255 882	27 000 000
1971	495 454	10 585 000	1 357 408	29 000 000
1972	571 944	12 045 000	1 566 969	33 000 000
1973	658 248	13 505 000	1 803 419	37 000 000
1974	764 248	14 235 000	2 093 830	39 000 000

	AVERAGE DAILY CONVERSATIONS PER 1000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	40	83	0	0
1965	42	87	5.0	4.8
1966	44	92	10.0	10.8
1967	48	106	20.0	27.7
1968	51	110	27.5	32.5
1969	57	123	42.5	48.1
1970	59	132	47.5	59.0
1971	63	140	57.5	68.6
1972	72	158	80.0	90.3
1973	82	176	105.0	112.0
1974	93	184	132.5	121.7

Sources: See "Local Telephone Calls" table.

TABLE 32

MINUTES OF WORKTIME REQUIRED IN SELECTED COUNTRIES TO EARN THE COST OF LETTER POSTAGE

COUNTRY	[a]ESTIMATED COMPENSATION PER HOUR	ESTIMATED COST OF LETTER POSTAGE IN NATIONAL CURRENCY FEBRUARY 3, 1976	MINUTES OF WORKTIME REQUIRED TO EARN THE COST OF LETTER POSTAGE
Australia	2.99 dollars	0.18 dollars	3 min. 37 sec.
Belgium	202.30 francs	6.50 francs	1 min. 56 sec.
Canada	5.35 dollars	[b]0.08 dollars	54 sec.
France	16.25 francs	0.80 francs	2 min. 57 sec.
Japan	782.00 yen	50.00 yen	3 min. 50 sec.
Netherlands	13.24 guilders	[c]0.50 guilders	2 min. 16 sec.
Sweden	24.29 kronas	1.00 kronas	2 min. 28 sec.
Switzerland	14.36 francs	0.40 francs	1 min. 40 sec.
United Kingdom	1.108 pounds	0.085 pounds	4 min. 36 sec.
United States	5.70 dollars	0.13 dollars	1 min. 22 sec.
West Germany	13.67 marks	0.50 marks	2 min. 12 sec.

[a] Preliminary estimates from U.S. Bureau of Labor Statistics for 1974. Represents wages of manufacturing workers and value of fringe benefits.

[b] Wage negotiations from the postal strike, which began in Oct. 1975, may result in increased costs.

[c] Rate increase to 0.55 guilders planned for April 1, 1976.

Source: U.S. Senate, Committee on Post Office and Civil Service, *Problems of the U.S. Postal Service*, 94th Cong., 2d Sess., 1976, p. 41.

TABLE 33

MAIL*

	TOTAL FIRST CLASS (millions)		PIECES PER CAPITA		PIECES PER CAPITA % CHANGE OVER 1965	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	NA	38448	NA	201	–	–
1965	2180	39697	111	205	0	0
1966	2384	42250	119	216	7.2	5.3
1967	2490	44109	122	223	9.9	8.7
1968	2586	45132	125	225	12.6	9.7
1969	2532	48068	121	238	9.0	16.0
1970	2708	50174	127	246	14.4	20.0
1971	2723	51493	126	250	13.5	21.9
1972	2936	50293	134	242	20.7	18.0
1973	3141	52291	142	249	27.9	21.4
1974	3347	52929	149	252	34.2	25.4

	TOTAL THIRD CLASS (millions)		PIECES PER CAPITA		PIECES PER CAPITA % CHANGE OVER 1965	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	NA	18599	NA	98	–	–
1965	1507	19454	77	101	0	0
1966	1318	20305	66	104	–14.2	2.9
1967	1367	20985	67	106	–12.9	4.9
1968	1331	20664	64	103	–16.8	1.9
1969	1375	19622	65	97	–15.5	–3.9
1970	1206	19974	57	98	–25.9	–2.9
1971	941	20532	44	100	–42.8	–0.9
1972	1206	21908	55	105	–28.5	3.9
1973	1007	22689	46	108	–40.2	6.9
1974	1144	22537	51	107	–33.7	5.9

* Domestic originating.

Sources: Canada Post Office, *Annual Report 1970*, p. 20; *1971*, p. 11; *1973*, p. 13; *1974*, p. 14.
Statistical Abstract of the United States 1968, p. 496, T725; *1969*, p. 494, T725; *1970*, p. 490, T747; *1973*, p. 493, T800; *1974*, p. 498, T821; *1978*, p. 587, T967.

CHART 11

PIECES OF FIRST CLASS MAIL PER CAPITA

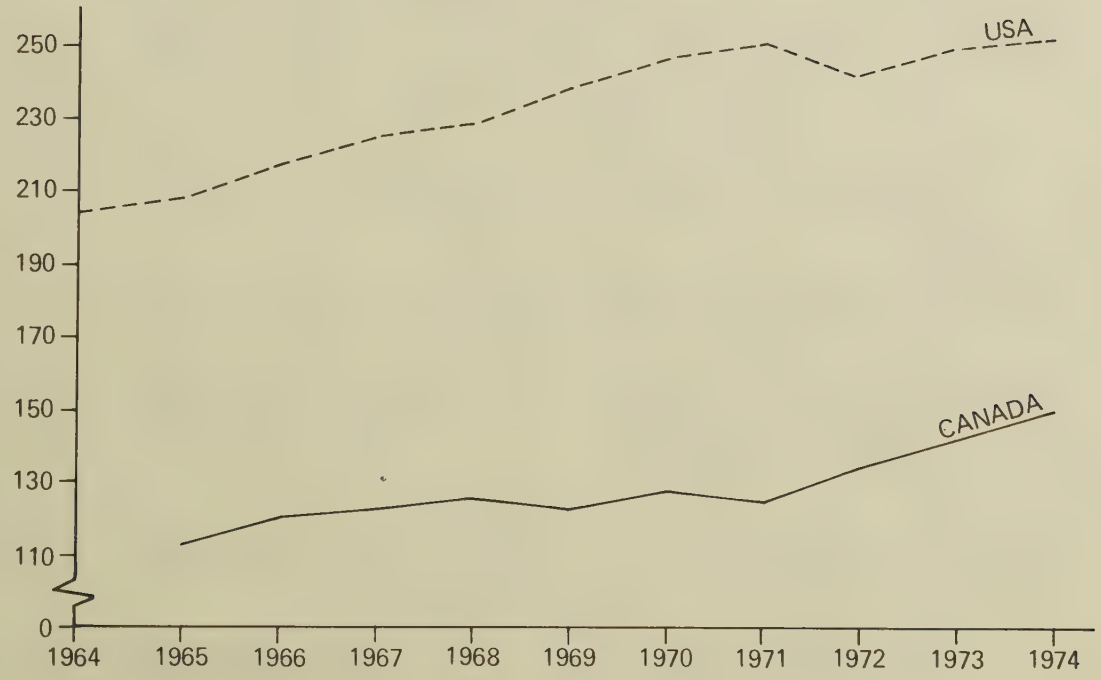

TABLE 34

DAILY NEWSPAPERS

	TOTAL NUMBER	
	CANADA	USA
1964	119	1763
1965	120	1751
1966	118	1754
1967	118	1749
1968	118	1752
1969	119	1758
1970	120	1748
1971	120	1749
1972	119	1761
1973	121	1774
1974	121	1768

	RATE PER 100 000 INHABITANTS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	0.62	0.91	0	0
1965	0.61	0.90	–1.6	–1.0
1966	0.58	0.89	–6.4	–2.1
1967	0.57	0.88	–8.0	–3.2
1968	0.56	0.87	–9.6	–4.3
1969	0.56	0.86	–9.6	–5.4
1970	0.56	0.85	–9.6	–6.5
1971	0.55	0.84	–11.2	–7.6
1972	0.54	0.84	–12.9	–7.6
1973	0.55	0.84	–11.3	–7.6
1974	0.54	0.83	–12.9	–8.8

Sources: *Statistical Abstract of the United States 1967*, p. 519, T746; *1969*, p. 504, T745; *1974*, p. 508, T844; *1978*, p. 597, T991.
Canada Year Book 1967, p. 892, T12; *1968*, p. 890, T12; *1969*, p. 904, T12; *1970–71*, p. 992, T12; *1972*, p. 974, T12; *1973*, p. 680, T16.8; *1975*, p. 656, T16.8.

TABLE 35

DAILY NEWSPAPER CIRCULATION

	TOTAL CIRCULATION (000s)		RATE PER CAPITA	
	CANADA*	USA	CANADA	USA
1964	4385	60412	0.22	0.31
1965	4271	60358	0.21	0.31
1966	4336	61397	0.21	0.31
1967	4432	61561	0.21	0.30
1968	4527	62535	0.21	0.31
1969	4549	62060	0.21	0.30
1970	4572	62108	0.21	0.30
1971	4692	62231	0.21	0.30
1972	4736	62510	0.21	0.29
1973	4804	63147	0.22	0.30
1974	4867	61877	0.22	0.29

* Circulation not reported for all newspapers.

Source: See "Daily Newspapers" table.

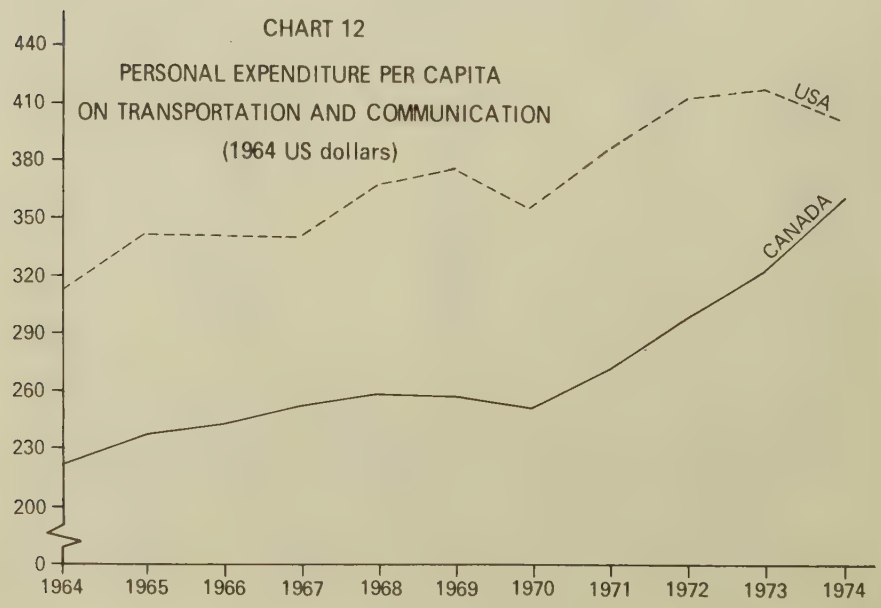

TABLE 36

PERSONAL EXPENDITURE ON TRANSPORT AND COMMUNICATION
(millions of current dollars)

	TOTAL EXPENDITURE		
	CANADA	CANADA IN US DOLLARS	USA
1964	4 612	4 276	59 667
1965	5 170	4 796	67 459
1966	5 540	5 142	70 167
1967	6 008	5 569	73 045
1968	6 532	6 062	83 480
1969	6 937	6 442	90 462
1970	7 025	6 729	91 472
1971	7 833	7 756	105 410
1972	8 838	8 922	116 972
1973	10 240	10 238	125 769
1974	12 561	12 845	134 664

	CONSTANT 1964 US DOLLARS					
	TOTAL (millions)		PER CAPITA		% CHANGE OVER 1964 OF PER CAPITA EXPENDITURE	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	4276	59 667	221	310	0	0
1965	4644	65 327	236	336	6.7	8.3
1966	4848	66 160	242	336	9.5	8.3
1967	5986	66 712	249	335	12.6	8.0
1968	5324	73 312	257	365	16.2	17.7
1969	5397	75 789	256	373	15.8	20.3
1970	5346	72 665	251	354	13.5	14.1
1971	5883	79 953	272	386	23.0	24.5
1972	6559	85 986	300	411	35.7	32.5
1973	7145	87 774	323	417	46.2	34.5
1974	8105	84 973	361	401	63.4	29.4

Sources: OECD, *National Accounts of OECD Countries 1961–1972*, p. 46, T1; *1962–1973*, p. 10, T1, p. 26, T1; *1960–1977*, p. 10, T5a, p. 22, T5a.

CHAPTER 11

HOUSING

"Houses are built to live in, not to look on; therefore, let use be preferred before uniformity, except where both may be had."

Francis Bacon

1. INTRODUCTION

This chapter begins with a review of housing accommodations as a bundle of attributes (Section 2), and proceeds to a discussion of arguments from basic rights and welfare considerations that have been used to try to improve the North American housing delivery system (3). Household numbers and sizes are presented in the next section (4), with an examination of crowding, plumbing deficiencies and homeownership. Section 5 contains statistics on personal expenditures on and satisfaction obtained from housing. In Section 6 I consider new housing units, with special reference to single family detached dwellings and the achievements of estimated national requirements. That is followed by a review of numbers of and dollar losses from building fires (7). In the final section (8) I summarize the chapter and combine its results with all previous chapters.

2. THE HOUSING BUNDLE

In one of the introductory sections of their excellent collection of articles on housing, Pynoos, Schafer and Hartman quite correctly observed that

"Traditionally the quantity of housing demanded and supplied has been discussed in terms of dwelling units available for habitation. This, however, is an inadequate description of the commodity for sale or rent in the housing market. It is more accurate to think of housing as a bundle of attributes, such as: square feet of living space, number of rooms, structure type (single-family detached, town houses, garden-style apartments, multifamily apartment buildings), accessibility to various activities (employment, recreation, shopping), the quality and quantity of various public and quasi-public services (schools, police, garbage collection, fire protection), type of neighbors (class, life-style, race, education), and neighborhood environment and design."[1]

As extensive as their list is, it's not yet the whole story. In the following passage, Holleb calls our attention to four more features of the housing bundle.

"Housing is . . . unique among durable consumers goods. It is by far the most durable, often lasting beyond the lifetime of its original inhabitants. Housing and related expenditures usually absorb the single largest share of the family budget, always for lower income families and a house is often a family's most valuable asset. Home ownership also has symbolic value, especially for working class families, and upward social mobility is frequently expressed in physical mobility, by moving to a better neighborhood. For families with higher incomes, there are tangible financial tax benefits as well."[2]

To all of this we must add Mead's view that

" . . . the structure of a house, of a neighborhood, and of a city is in itself educational that we teach children or migrants, immigrants into the city by the way it is structured, an enormous number of things about life, about how to be friendly and about who is a stranger, what privacy means, what intimacy means, what areas are safe and what areas are dangerous. We teach them about cleanliness and health and beauty, or the lack of it, by the way in which we structure houses and the way we structure our neighborhoods and our cities."[3]

As you might expect by now (unfortunately), there is a significant gap between the number and kinds of important features of the housing bundle and relevant statistical measures. Little has changed since Pynoos, Schafer and Hartman wrote in 1973 that "The poor quality of [U.S.] census data on housing conditions is widely recognized."[4] The remark is applicable to Canadian data too, since the focus here is also on structural conditions (mainly plumbing), crowding, prices and financing.[5] Although no one would claim that these features are unimportant, they do seem to represent a bare minimum out of the total bundle.

3. WELFARE, RIGHTS AND CRISES

In the twentieth century housing has emerged as a highly visible public issue in North America in two periods, namely, in the decade we are examining and that around 1936 to 1946. According to the Canadian Federal Task Force on Housing and Urban Development, the issue was first raised by Franklin D. Roosevelt. "Anguished that one-third of his nation was 'ill-housed, ill-clad and ill-nourished,' the late President held out the promise of 'decent, safe, and sanitary dwellings within the financial reach of families of low-income.' So in 1937 began the rush to public housing in the United States. More than a decade later, following the veterans' housing program, it came to Canada."[6]

The Act designed to provide housing for veterans was called simply 'The National Housing Act of 1944'.[7] The National Housing Act of 1954 was a bit more ambitious, aiming " . . . to Promote the Construction of new Houses, the Repair and Modernizationof existing Houses and the Improvement of Housing and Living Conditions."[8] Still, it was pretty prosaic stuff compared to the United States Housing Act of 1949. In the latter,

"The Congress hereby declares that the general welfare and security of the Nation and the health and living standards of its people require housing production and related community development sufficient to remedy the serious housing shortage, the elimination of substandard and other inadequate housing through the clearance of slums and blighted areas, and the realization as soon as feasible of the goal of a decent home and a suitable living environment for every American family, thus contributing to the deveopment and redevelopment of communities and the advancement of the growth, wealth and security of the Nation."[9]

The driving force behind the public concern with housing in this early period was a consideration of human well-being or welfare.[10] Although poor folks were not entitled to adequate housing, the idea seems to have been, it would be a good thing for them to have it. It would also be good for the souls of the not-so-poor folks to provide it. Souls aside, it could hardly have escaped anyone's notice that people who live in poor houses often throw stones, so to speak, at those who don't. Problems bred in slums tend to flourish in other areas. Fires, diseases, pests and criminal activity cannot be contained by zoning laws. Thus, improved housing conditions seemed to be clearly in the interests of not-so-poor as well as poor folks.

As it turned out, no one was able to demonstrate that nice housing bred nice people.[11] Like mother's chicken soup, it couldn't hurt; but that didn't do much for the reformer's case. Insofar as the welfare of only poor folks was likely to be improved by better housing funded by government, public concern tended to wane. It waned until the turbulent late 60's and early 70's, when wishes and requests were abandoned in favour of demands. In 1969 the Task Force on Housing declared that "Every Canadian should be entitled to clean, warm shelter as a matter of basic human right."[12] With the Housing Act of 1968, the American government established a national goal of 26 million new or rehabilitated housing units in ten years. Twenty million were to be unsubsidized units and the rest subsidized for low- and moderate-income families.[13] Clearly, a new day had dawned for housing policy. It's not clear yet that a new day had dawned for the delivery of adequate housing.

Besides the rhetoric concerning rights and specific targets, there was a lot

of crisis talk. In 1971 Stone claimed that "The United States is in the midst of a severe housing crisis. There are not enough dwelling units in decent condition, at appropriate locations, with required amenities and secure tenure and at bearable prices."[14] Two years earlier the Economic Council of Canada warned that "If there should be any clear sign that new housing starts are falling off in a significant way, possible remedial actions should be quickly considered. We are now in a situation in which a major housing crisis could develop within a very short period of time."[15] The following year Diamond identified three "reasons for the mounting crisis and the deep concern about housing," namely, the (1) rapidly increasing costs of shelter, (2) decreasing range of choices of dwelling types and (3) "thwarted expectations of large groups of our population for better housing at a price they can afford."[16]

On the contrary, Lithwick argued that such crisis talk was "nonsense."[17]

> "Mr. Hellyer's Task Force on Housing and Urban Development has been set up to wage war on the 'urban crisis'. Since there is no evidence of an urban crisis in Canada, . . . who needs the Hellyer Task Force? . . . If we can infer anything from the timing of the Task Force and its composition, it is that the real issue with which they are concerned is housing, particularly because of the recent inflation of prices and the finding that much of our housing stock is of inferior quality. Can we then say that we have a housing crisis? . . . It has been found that there exists well-defined and well-documented swings in the housing market, from surplus to shortage and back to surplus. . . . Since we are merely going through a typical phase of the housing market adjustment process there can be little call for a crisis approach and its correlative, panic policy making.
>
> . . . At the same time it must be stressed that the price of housing has gone up much less than all other major items which consumers buy over the past decade and longer. If the crisis is one of price increase, the housing market is certainly among the least obvious candidates for remedial policy. . . .
>
> What then is this crisis we are told exists and must be dealt with expeditiously? There is a real one facing lower income groups, who can only afford substandard housing. But their problem is one of poverty, not housing. . . .
>
> Then we have the middle income group who would like to have housing but cannot afford new single family units, and it is their plight that appears to define the housing crisis. . . . If the crisis is that we are unable to provide these houses at present prices, or that at higher prices they cannot be purchased, then the problem is artificial."[18]

For our purposes it's not necessary to decide whether or not the crisis talk was warranted, either in the interests of accurate description or of generating appropriate remedial activity. However, it is worthwhile to emphasize that the welfare and rights views of adequate housing are not logically incompatible. They should be regarded as more or less independent considerations in favour of pressing for "a decent home and a suitable living environment for every [North] American family." If one accepts the general principle that

people have a right to life (i.e., to live at all, not necessarily well, pleasantly, fully, happily, etc.), then one ought to accept the corollary right to adequate housing. After all, adequate shelter is a necessary condition of life.

Unfortunately, very little seems to follow from the admission that people have a right to adequate shelter. One could still haggle about whether the right is positive (implying that the government ought to do something to provide housing) or negative (implying that the government ought to do nothing but allow people to find housing). What's more, even if it's granted that people have a positive right to housing, one could haggle about the quantity, quality and conditions of government provision. Once the level of haggling reaches this point, my guess is that rights talk will tend to give way to welfare talk, i.e., to talk about the benefits and costs (in the broadest senses of these terms) of this or that sort of provision. The more rapidly and thoroughly considerations of rights are analyzed into considerations of welfare, the less independent the two kinds of considerations must be. In my view, which might be characterized as naturalistic, consequentialist, utilitarian or pragmatic, all considerations of rights can (logically) be eliminated in favour of considerations of human welfare. So the decision to base one's arguments in favour of government provisions for housing can safely turn on substantive rather than merely logical considerations.

4. HOUSEHOLDS AND CONDITIONS

The term 'household' is used to designate any person or group occupying one dwelling unit. It is contrasted with 'family' which designates a group of people with some biological or legal relations. (I will have more to say about families in Volume V, Chapter 14.) In 1974 there were nearly 6.5 million households in Canada and 69.8 million in the United States (T1). That was an increase over 1964 of 33% for the former country and 25% for the latter.

On the average every Canadian household had 3.27 people in it in 1974, compared to 2.97 in every American household (T2). Throughout the decade the average Canadian household was bigger than its American counterpart. That is probably a result of the fact that the Canadian population is generally younger[19] and that most of the groups living in households are families with children. In both countries there was a steady decline in the average size of households. In Canada the decrease over 1964 was 15%, compared to 10% in the United States.

Tables 3 and 4 provide a detailed view of the distribution of households of various sizes, ranging from individuals living alone to groups of seven or more

people. In the last year for which we have comparable statistics, 1971, it is clear that Americans had both higher percentages of one and two person households and lower percentages of households with five or more members (T3). Forty-seven percent of American households had one or two persons, compared to 39% of Canadian households (T4).

Although Greenfield and Lewis correctly asserted that "no standard definition of 'adequate' housing has been developed,"[20] two primitive measures are frequently used as rough indicators of adequacy. The first measure concerns crowding, and it is simply the ratio of the number of persons to the number of rooms occupied by the members of any household (excluding "attics, hallways, alcoves, pantries and bathrooms").[21] "Generally, the person per room ratio uses 1.5 persons or more per room as evidence of overcrowding."[22] If the person per room ratio exceeds unity, it's assumed that there is at least some crowding. According to the 1970 American census, 8% of the occupied dwelling units were crowded (T5, F1).[23] The 1971 Canadian census disclosed 9.4% crowed units (T5, F1). For Americans that was a 30% decrease over 1960, while it was a 43% decrease over 1961 for Canadians.

Following current practice then, we may regard the percent of crowded houses as a negative social indicator.[24] The only indicator values available are for the census years in both countries; 1960 and 1970 for the United States, and 1961 and 1971 for Canada. So we will be comparing stock values for adjacent rather than matching years, and ten-year rather than annual flow values. Hence, the United States gets 2 points for its superior stock values in the census years, and Canada gets 1 point for its superior flow from one census year to the text.

The second frequently used measure of housing adequacy concerns plumbing. If a dwelling lacks running water or if its occupants do not have exclusive use of a bath, shower or flush toilet, then the housing is regarded as inadequate.[25] The ratio of the number of inadequate units to all occupied units is used as another negative social indicator.[26] In 1970 5% of the occupied dwelling units in the United States were inadequate on the basis of plumbing deficiences (T6, F2). In the following year 9% of the occupied units in Canada were inadequate (T6, F2). That was a 69% decrease over a ten year period for the United States, and a 60% decrease for Canada. In our general assessment then, the United States gets 2 points for its superior stock values on this indicator and 1 more for its preferable flow between census years.

It is perhaps worthwhile to mention that the underlying concern behind both of these primitive measures of housing adequacy seems to be personal

privacy. Uncrowded units in which occupants have exclusive access to bathroom facilities provide opportunities (in principle at least) for individuals to be alone if they so choose. Given North American preferences for single family detached dwelling units,[27] there is no doubt that most of our people want such opportunities.

They also want to own their own homes. At the 1970 census 64% of the occupied dwelling units in the United States provided shelter for the units' owners (T7, F3). Sixty percent of the occupied units in Canada were occupied by owners in 1971 (T7, F3). That was nearly a 4% increase over the previous census year in the United States, and a 9% decrease in Canada.

Like most of my neighbours, I think that the benefits of home-ownership outweigh the costs.[28] Just as I prefer to not need permission to put on a particular pair of shoes or to sleep in a particular room every night, I prefer to have relatively unrestricted access to shelter. Most of all I would prefer to have the mortgage company out of my life forever; but that, I suppose, may never happen. Still, it seems preferable to make mortgage payments that theoretically might some day come to an end, rather than to make rental payments that theoretically will never come to an end. Regarding the percent of owner-occupied dwellings as a positive social indicator, the United States makes a point for its superior stock value in 1970 and another point for its preferable ten year flow. Canada makes a point for its preferable stock value in 1961.

In constant 1964 U.S. dollars, the median value of one-family, owner-occupied, non-farm dwellings was greater in Canada in 1971 than in the United States in 1970 (T8). The median Canadian value was 14 285 dollars, compared to 13 505 dollars in the United States. Since we have already seen that Canadians had higher percentages of crowded and plumbing-deficient houses than Americans in those years, there's a good chance that Canadians tended to pay more than Americans for less adequate housing. That is certainly consistent with my own and some other home-owners' perceptions of the housing markets in the two countries. More importantly, it's also consistent with a report from The Conference Board in Canada.[29] Thus, rather than treating median housing (dollar) values as positive indicators because (if all other things are roughly equal) it's better to have a more rather than a less valuable house, I would be inclined to regard such values as negative indicators. Even if it's granted that Canadians would have a relatively bigger bundle of cash to spend than Americans if they turned their houses into cash, I think my view is still sound. If housing is indeed over-priced in Canada compared to the United States, then the best a Canadian could do (short of

changing countries) is trade over-priced ownership for over-priced renting. On the basis of the decreasing percentage of owner-occupied and the increasing percentage of renter-occupied dwelling units in Canada, it's fair to say that increasing numbers of Canadians are making precisely such a trade. That's unfortunate, because it's probably nothing more than the choice of the lesser of two evils. Fortunately, however, we don't have to use median (dollar) values in our general assessment at all. Any housing expenditures actually made in the 1964 to 1974 period will be included in T9, and my policy on such expenditures is unequivocal.

5. EXPENDITURES AND SATISFACTION

In 1974 Canadians spent 658 (1964 US) dollars per capita on housing, compared to 795 dollars spent by Americans (T9, C1). That was an increase over 1964 of 68% for the former and 37% for the latter. If, as suggested in the previous paragraph, it's fair to assume that dollar-for-dollar Canadians probably got less than Americans for money spent on housing, then the fact that Canadians also tended to spend less seems reasonable and desirable. Following my general policy, personal expenditures per capita on housing are negative social indicators. Hence, Canada makes 11 points for its preferable stock values and 4 more for its annual flows. The United States makes 6 points for its preferable annual flows.

Per capita expenditures on housing provide a rough view of the dollar costs connected to the satisfaction of shelter needs and wants. National responses to the AIPO and CIPO question "On the whole, would you say that you are satisfied or dissatisfied with your housing situation?" provide an equally rough view of the psychological benefits connected to the variety of living arrangements actually purchased. In the 1963 to 1973 period the question was raised 4 times in Canada and 6 times in the United States (T10, F4). In the two years in which it was raised in both countries simultaneously, 1963 and 1973, the responses were essentially the same. In 1973 76% of Canadians and 74% of Americans said that they were satisfied with their housing situation. In 1963 the figures were 77% and 72%, respectively, for Canada and the United States. Allowing for measurement errors, no significant differences appeared across time or national borders. As if this were not remarkable enough, the highest percentages of satisfied respondents were recorded in 1969 (USA) and 1970 (Canada), practically at the zenith of public discussions on the housing crises in both countries. While the 78% American figure is not extraordinary, the 86% Canadian figure is. The latter is statistically

significantly higher than any other recorded figure for the housing satisfaction question, and it follows the very lowest figure obtained for that question by only two years. As far as I have been able to discern, the lowest figure came before any major official gloomy pronouncements were made, and the highest figure came before any major official roseate solutions were offered. There's no evidence of a massive movement of families in the 1968 to 1970 period. Besides, the idea that there might have been something like a game of musical chairs played with houses and resulting in huge increases in satisfaction is at best farfetched. Furthermore, as we will see shortly, although there were more new housing units started in 1969 than in 1968, there were fewer started in 1970 than in 1968 (T11). In short, I just don't know how to account for the extraordinary Canadian figures.

Since satisfaction with one's housing situation is an important feature of the quality of one's life and directly related to satisfaction with life as a whole,[30] the percent of people expressing such satisfaction should be regarded as a positive social indicator. Given the essential similarity of Canadian and American feelings on this issue, nothing has to be added to our comparative assessment.

6. NEW HOUSING UNITS

One of the most frequently cited time series in the housing field is the annual number of new housing units started (T11). In 1974 there were over 222 000 new units begun in Canada and 1 352 000 in the United States. That was 3421 and 1935, respectively, for every 100 000 Canadian and American households (T11, C2).

Given the information in Section 3, I suppose one would be inclined to think that there was a shortage of dwelling units in both countries and that, therefore, the more new units the better. That is, one would be inclined to treat the new unit rate per 100 000 households as a positive social indicator. However, one might do a bit better than that in two ways, namely, by considering the percent of single family detached dwellings and the degree to which total construction satisfies estimated requirements (goals, targets, needs). I will consider the case for each alternative in turn.

There is no doubt at all that the majority of North Americans prefer single family detached houses to any other style of dwelling unit. "The overwhelming preference of the American family in housing" Glazer wrote, "is the single-family home, preferably owned, preferably detached. Our housing policy at local and federal levels has been designed to facilitate its

building, to promote its environment, and to make it accessible to more and more people at lower economic levels."[31] Then he cited a review article "summarizing 11 opinion studies in 1953" in which it was asserted that "whenever given the opportunity, most American families express their desire to own their own homes."[32]

The fact that most Canadians want to have such housing

" . . . was one of the more unanimous impressions the Task Force evolved from its cross-country tour. It was enlightening, if not humorous, for the Members to hear a continuous flow of expert testimony that future housing policies must be directed to the provision of multiple-unit accommodation, largely on a rental basis, while group after group of ordinary citizens voiced a deep yearning to own a single-family dwelling of their own. It became the practice of the Task Force, at its public meetings with various groups, to seek a show of hands on this question. Invariably the response indicated that at least 80% of those present wanted to own their own home, the same figure incidentally which Professor Edward Michaelson of Toronto obtained in a more scientific sampling."[33]

Bellush and Hausknecht claimed that in the United States

"Homeownership . . . is a symbol of civic virtue – it is regarded as a prerequisite for the integrity of the social system. It is not surprising to learn that Herbert Hoover once intoned, 'The present large proportion of families that own their own homes is both the foundation of a sound economic and social system, and a guarantee that our society will continue to develop rationally as changing conditions demand.' Some, however, may be disconcerted to hear this echoed in Franklin D. Roosevelt's assertion that 'a nation of homeowners, of people who own a real share in their own land, is unconquerable.' But the sentiments will not surprise those who recall Thomas Jefferson's exhaltation of the yeoman farmer or the ideological underpinnings of the Homestead Act of 1862. In the 20th Century, the virtues of the yeoman farmer and the sterling pioneer are embodied in 'the homeowner'."[34]

Practically the same sentiments were expressed by the Canadian Task Force when they wrote that

" . . . there continues to be widespread, if not universal, support for the time-worn concept that a home-owner is a better citizen of his community and his country than a tenant and that to have one's roots in the soil of home-ownership is to be stablized against the vagaries and pressures of modern society."[35]

To housing "experts", as the Task Force suggested, the widespread desire for homeownership in its most common form of single family detached dwellings is at best problematic. According to Murray,

"One single family house may offer very real and understandable attractions as a way of living – privacy, independence, individuality. Twenty may present opportunities for

pleasant groups, for diversity, for making interesting exterior spaces, but 20 000 such houses built together shifts from dream to nightmare, and the cliches of description all to readily spring to mind – subtopia, sprawl, strawberry boxes – only to be matched by the desparate design cliches which attempt to ameliorate the problem. And, so it is with 100 apartments, 1000 apartments or 10 000 apartments. The problem is simple to state and difficult to solve – to retain in housing design human individuality and diversity and to make apparent the larger community structure which gives meaning to the whole."[36]

Quite apart from the design problems, Auld claimed that

"We also have to consider the desirability for society of developing policies making it *affordable* for all households to live in a single family detached unit. In terms of consumption of land, servicing costs, energy consumption, etc., I think this would be a rather unwise policy direction."[37]

The question we have to ask now is just this: Should the percent of single family detached dwelling units in all new housing starts be regarded as a positive, negative or an unclear social indicator? We seem to have public opinion on the positive side and "expert" opinion on the negative or unclear side. As I have reflected on the issues, I have come down on both sides at different times. At present I favour the positive side. I think that such problems as sprawl, monotonous uniformity, excessive consumption of energy and materials are primarily problems of design or technology. They are problems of the way we build houses rather than problems of single family detached dwellings. Although some researchers have argued that the level of technological innovation in the construction industry is comparable to that in some other industries,[38] no one thinks the construction industry is a technological leader.[39] Moreover, virtually everyone thinks that the vast majority of official building codes in Canada and the United States are out of date and restrictive with respect to the introduction of new materials and procedures.[40] So far as the consumption of energy and materials are concerned then, it seems that instead of objecting to a particular housing style, one ought to object to the construction industry's style of production. Similarly, since single family detached dwellings were around long before suburban sprawl, one should not object to the former as if they entailed the latter. On the issue of monotonous uniformity, it's well to recall Murray's observation that

"Design does not create the one dimensional suburban society, it reflects it: for design is an uncomfortable embarrassingly accurate mirror of non-design factors in the culture it serves: social stratification, tenuous suburban densities, corsetting by-laws, monotonous standardized components, shortsighted economic formulae. Even those processes and procedures with commendable ambitions – the official plans, the zoning by-laws, the endless committees and boards, increasingly frustrate attempts at new solutions."[41]

The issue of land consumption looks more problematic than it is. There is plenty of land in North America. The trouble is that too many people continue to use good agricultural land for nonagricultural purposes. That, of course, is not a problem of housing style, but of land use. Even if we never build another single family detached house, as long as we cover prime agricultural land with buildings, asphalt or concrete we are engaged in self- and social-destruction. So, we are better off getting that message through than we are worrying about housing styles, any styles.

Besides being unimpressed by the arguments against single family detached dwellings, I am impressed by the arguments against multiple family dwellings. Although it is far from clear that population density itself causes individual and social pathologies, it's unlikely that there is no connection or that high density makes only a positive contribution.[42] It is certainly the case that the higher the density, the greater the demands are for individual and group management and control. Two or three hundred people can't occupy an acre with the same amount of freedom of movement that 20 or 30 people might have. There must be some organization, some generally accepted "rules of the road" in order to have civilized commerce instead of utter chaos. Hence, concentration of people contributes directly to centralization and bureaucratization, with all of their undesirable consequences.

Clearly, there is no need to have only single or else multiple dwellings constructed. Indeed, it's equally clear that a finely tuned production system would provide a mixture of dwelling types for a variety of individual and family requirements. More precisely,

> "An effective housing delivery system . . . would be programmed to accommodate all new households, to replace occupied substandard houses with decent dwellings, and to enable low income families to secure adequate housing services within their means. It would permit reasonable freedom of choice for individual households with respect to location, price, style, and owner or rental tenure. There would be no wide disparities in the quality of essential public goods and services particularly in such functions as primary and secondary education, health and sanitation, and welfare. The financial support of these basic public requirements would be independent of the location of physical assets within the metropolitan or urban area – that is, reliant upon revenues other than the local property tax. The system would take full advantage of economies of scale potentially available in certain public investments such as sewage treatment facilities. And it would induce the most efficient private producers and production levels in housing through standardized development rules, prompt public decisions, and guaranteed markets."[43]

Granting all the complications and considerations that I have just presented, I'm still inclined to regard the percent of single family detached

dwelling units in all new housing starts as a positive social indicator. In 1974 66% of American and 55% of Canadian new units were single family detached (T12, C3). That was an increase over 1964 of 7% in the United States and 17% in Canada. Throughout the decade the American percentages of such units were higher than the Canadian. Hence, the United States makes 11 points for its preferable stock values. For its preferable annual flows, the United States and Canada each makes 5 points.

The other indicator to be considered relative to new construction concerns the degree to which estimated national housing requirements or goals have been achieved. In the United States our work has been done for us by the Department of Housing and Urban Development, and the Subcommittee on Housing Panels of the House of Representatives Committee on Banking and Currency (T13, C4). The Canadian picture is less clear. Estimates of the number of new dwelling units required every year in the 1964 to 1974 period vary from 145 000[44] to 250 000.[45] The most frequently mentioned figure is 200 000 units, which was endorsed by the Task Force on Housing and Urban Development.[46] Although a 200 000 estimate has been attributed to the Economic Council of Canada,[47] that seems to have been merely a rough summary of the Council's view. In the *Sixth Annual Review* the Council put the estimated annual demand for the 1961–66 period at 140 000 units, for 1966–71 at 190 000 units and for 1971–76 at 230 000 units.[48] These estimates

> " . . . take into account not only the further rapid growth in new family and household formation, but also the needs generated by population migration in Canada, the movement from shared households into separate households, replacement of existing housing as a result of obsolescence and demolitions, some improvement in housing quality, and urban renewal. Allowance has also been made for an increase in the present very low stock of vacant housing; . . . "[49]

The Canadian figures in T13 were obtained by dividing the production figures from T11 by the Council's estimated requirements. For the years in which two estimates were given (1966 and 1971), I used the mean of the estimates as an estimate. Thus, in 1974 97% of the estimated number of required new dwelling units in Canada were actually started. In the United States only 71% of the goal was achieved. In 7 out of 10 years Canada exceeded its requirements, while the United States exceeded its requirements in only 3 years. Since the achievement of reasonable and desirable goals is vitally important for living a good life,[50] the percent of national housing goals actually achieved should be regarded as a positive social indicator.

Accordingly, Canada makes 7 and the United States makes 3 points for its superior stock values. For its superior annual flows Canada makes 3 points and the United States makes 6.

Before closing this discussion of new dwelling units, a few remarks about mobile homes are in order. In 1974 26957 mobile homes were shipped to dealers in Canada, and 329 000 were shipped to dealers in the United States.[51] If these units were added to the new unit figures in T11, then the Canadian performance of 1974 would be 108% of estimated requirements, and the American performance would be 88%. Because mobile homes don't have the durability, size or popularity of ordinary homes, I have not included them in our basic housing statistics. Nevertheless, they are certainly available and increasing in numbers.

7. FIRES AND LOSSES

Tables 14 and 15 provide a summary of the numbers of and dollar losses from building fires generally and residential fires in particular. In 1974 Canadians lost 12.33 (1964 U.S.) dollars per capita in fires, compared to 9.71 dollars lost by Americans (T14, C5). As C5 clearly shows, the 1974 figure in Canada was dramatically higher than the 1972 figure. Over 1864, there was a 73% increase in Canada and a 37% increase in the United States.

About a third of the Canadian dollar losses in building fires in 1974 was accounted for by residential units (T15). In the United States about 40% of the building fire losses were in residential units. Residential fire losses increased 109% over 1964 in Canada, and 64% in the United States.

Since dollar losses in fires are generally undesirable, either the building or residential time series would seem to qualify as a plausible negative social indicator. Although the focus of this chapter has been on residential units, any building fire losses are regrettable. So, I prefer to use the broader rather than the narrower time series. Hence, Canada gets 7 points for its smaller fire losses and the United States gets 4. For its smaller annual flows, Canada gets 4 points and the United States gets 6.

8. SUMMARY AND RESULTS

The results of my comparative assessment based on the 7 usable social indicators identified in this chapter are summarized in the following matrix.

SOCIAL INDICATOR	CANADA STOCK	CANADA FLOW	USA STOCK	USA FLOW
1. Crowded housing	0	1	2	0
2. Adequate plumbing	0	0	2	1
3. Home ownership	1	0	1	1
4. Housing expenditures	11	4	0	6
5. New single family dwellings	0	5	11	5
6. Achieved housing requirements	7	3	3	6
7. Building fire losses	7	4	4	6
Housing Subtotal	26	17	23	25
Housing Total	43		48	
Previous Total	672		575	
Combined Total	715		623	

With respect to the general area of housing, the quality of life in the United States is higher than that in Canada. The final area score is 48 to 43. If the results of previous chapters are added to those of this chapter, the quality of life in Canada still looks higher than that in the United States. The combined score is 715 to 623.

If one looks at the first and last recorded stock values for the usable indicators for each country independently of the other country, one may get a sense of the direction in which the two countries have been moving. The results of this examination are summarized below.

SOCIAL INDICATOR	CANADA BETTER	CANADA WORSE	USA BETTER	USA WORSE
1. Crowded housing	1	0	1	0
2. Adequate plumbing	1	0	1	0
3. Home ownership	0	1	1	0
4. Housing expenditures	0	1	0	1
5. New single family dwellings	1	0	1	0
6. Achieved housing requirements	0	1	0	1
7. Building fire losses	0	1	0	1
Housing Total	3	4	4	3
Previous Total	40	28	37	30
Combined Total	43	32	41	33

In the area of housing, the United States improved in more ways and deteriorated in fewer ways than Canada. When these results are added to those of previous chapters, Canada's general picture looks a bit better than that of the United States. Canada has both improved in more ways and deteriorated in fewer ways than the United States. Nevertheless, each country's total independent performance so far has been favourable. Each country has on the whole become better in more ways than it has become worse, so far.

Putting all evaluations aside, the countries have tended to be or become similar with respect to the following.

1. Average population per household
2. Crowded housing
3. Adequate plumbing
4. Home ownership
5. Median value of houses
6. Housing expenditures
7. New single family dwellings
8. Achieved housing requirements
9. Residential fire losses

The countries have tended to be or become dissimilar with respect to the following.

1. Number of households
2. New housing units started
3. Building fire losses

In the area of housing then, the two countries tended to be or become similar in more ways than they tended to be or become dissimilar. If these results are added to those of previous chapters, then there are a total of 100 nonindependent paths that have tended to converge and 106 that have tended to diverge. These are summarized below

	NUMBER OF NONINDEPENDENT PATHS TENDING TO	
	CONVERGE	DIVERGE
Housing	9	3
Previous Total	91	103
Total	100	106

Considering only the most recent point at which the same question was

raised by the AIPO and CIPO or some other survey research team, Canadians and Americans gave essentially the same responses to the single question asked. It concerned satisfaction with housing in 1973. Thus, there are now a total of 32 questions that Americans and Canadians answered in essentially similar ways, and 35 questions that they answered in different ways.

Very briefly then, the combined evidence of this and previous chapters yields precisely the same three conclusions mentioned at the end of Chapter 9.

NOTES

[1] J. Pynoos, R. Schafer, and C. W. Hartman, 'Economics', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), p. 203.
[2] D. B. Holleb, 'A Decent Home and Suitable Living Environment', *The Annals of the American Academy of Political and Social Science* (1978), 435, p. 106.
[3] M. Mead in U.S. House of Representatives, Committee on Banking and Currency, Ad Hoc Subcommittee on Urban Growth, *Hearings, The Quality of Urban Life, Part 2*, 91st Cong., 1st and 2d Sess., 1969 and 1970, p. 425. See also W. Michelson, *Environmental Choice, Human Behavior, and Residential Satisfaction* (New York: Oxford University Press, 1977), pp. 15–18.
[4] J. Pynoos, R. Schafer, and C. W. Hartman, 'Introduction', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), p. 2.
[5] For example, see Central Mortgage and Housing Corporation, *Canadian Housing Statistics 1974* (Ottawa: Minister of Supply and Services, 1975).
[6] Federal Task Force on Housing and Urban Development, *Report* (Ottawa: Information Canada, 1969), p. 53.
[7] Central Mortgage and Housing Corporation, 'Housing in Canada 1946–1970', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh) (Waterloo, Ontario: University of Waterloo, 1972), p. 65.
[8] J. A. Murray, 'The Architecture of Housing', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh) (Waterloo, Ontario: University of Waterloo, 1972), p. 125.
[9] *Ibid.*
[10] Central Mortgage and Housing Corporation, 'Housing . . . ', pp. 69–70.
[11] J. Bellush and M. Hausknecht, 'Public Housing: The Contexts of Failure', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), pp. 116–117; W. Michelson, 'Determinism by the Urban Environment', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), pp. 171–180; K. S. Sayegh, 'Introduction', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh) (Waterloo, Ontario: University of Waterloo, 1972), p. xi.
[12] Federal Task Force on Housing and Urban Development, *op. cit.*, p. 22.
[13] U.S. House of Representatives, Committee on Banking and Currency, *Papers Submitted to the Subcommittee on Housing Panels, Part I*, 92d Cong., 1st Sess., 1971, p. 104.

[14] M. E. Stone, 'Federal Housing Policy: A Political-Economic Analysis', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), p. 423.
[15] Economic Council of Canada, *Sixth Annual Review: Perspective 1975* (Ottawa: Queen's Printer for Canada, 1969), p. 168.
[16] A. E. Diamond, 'Housing in the 1970's', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh (Waterloo, Ontario: University of Waterloo, 1972), pp. 226–227.
[17] N. H. Lithwick, 'Housing: In Search of a Crisis', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh) (Waterloo, Ontario: University of Waterloo, 1972), p. 91.
[18] *Ibid.* Similar views may be found in L. B. Smith, *Housing in Canada: Market Structure and Policy Performance* ('Urban Canada, Problems and Prospects: Research Monograph No. 2') (Ottawa: Minister of Supply and Services, 1971), p. 19; and J. W. Auld, 'Is There a Canadian Housing Problem? A Response to a Reply', *Impact* (September/October 1979), pp. 18–20.
[19] Volume I, Chapter 2.2, Table 3.
[20] R. J. Greenfield and J. F. Lewis, 'An Alternative to a Density Function Definition of Overcrowding', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), p. 167.
[21] *Ibid.*
[22] *Ibid.*
[23] According to a more sophisticated measure developed by Greenfield and Lewis, there were nine times as many crowded units as estimated by the census bureau, *ibid.*, p. 169.
[24] For current practice, see for example, U.S. Department of Commerce, *Social Indicators 1976* (Washington: U.S. Government Printing Office, 1977), pp. 78–80, 89–90.
[25] J. Pynoos, R. Schafer, and C. W. Hartman, 'Introduction', pp. 2–4.
[26] U.S. Department of Commerce, *op. cit.*, pp. 80–81, 91–92.
[27] See Section 6 for more on single family detached housing.
[28] There is more on home-ownership in Section 6, with special reference to single family detached units.
[29] J. G. Frank, *Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States* (Ottawa: The Conference Board in Canada, 1977), pp. 32–34.
[30] F. M. Andrews and S. B. Withey, *Social Indicators of Well-Being* (New York: Plenum Press, 1976); A. Campbell, P. E. Converse, and W. L. Rodgers, *The Quality of American Life* (New York: Russell Sage Foundation, 1976).
[31] N. Glazer, 'The Bias of American Housing Policy', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), p. 406.
[32] *Ibid.*, p. 408.
[33] Federal Task Force on Housing and Urban Development, *op. cit.*, pp. 15–17.
[34] Bellush and Hausknect, *op. cit.*, pp. 115–116.
[35] Federal Task Force on Housing and Urban Development, *op. cit.*, p. 17.
[36] Murray, *op. cit.*, p. 85.
[37] Auld, *op. cit.*, p. 19.
[38] C. A. Sims, 'Efficiency in the Construction Industry', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), pp. 329–339.

[39] *Ibid.*, p. 332; D. Nelkin, *The Politics of Housing Innovation: The Fate of the Civilian Industrial Technology Program* (Ithaca, New York: Cornell University Press, 1971), pp. 6–9, 12–13, 56–59.
[40] *Ibid.*, pp. 13–14; National Commission on Urban Problems, 'Building Codes', *Housing Urban America*, (ed. by J. Pynoos, R. Schafer, and C. W. Hartman) (Chicago: Aldine Pub. Co., 1973), pp. 343–371; C. Fowke, 'The Case for the National Building Code', *Canadian Housing: A Reader*, (ed. by K. S. Sayegh) (Waterloo, Ontario: University of Waterloo, 1972), p. 75.
[41] Murray, *op. cit.*, p. 85.
[42] Volume I, Chapter 2.3.
[43] U.S. House of Representatives, Committee on Banking and Currency, *op. cit.*, pp. 155–156.
[44] Murray, *op. cit.*, p. 87.
[45] Special Senate Committee on Poverty, *Poverty in Canada* (Ottawa: Information Canada, 1971), p. 162.
[46] Federal Task Force on Housing and Urban Development, *op. cit.*, p. 23.
[47] Lithwick, *op. cit.*, p. 91.
[48] Economic Council of Canada, *op. cit.*, p. 99.
[49] *Ibid.*, pp. 99–100.
[50] A. C. Michalos, 'Satisfaction and Happiness', *Social Indicators Research* (1980), 385–422.
[51] Statistics Canada, (42–217) *Truck Body and Trailer Manufacturers 1974* (Ottawa: Minister of Supply and Services, 1975), p. 16, Table 7; U.S. Department of Commerce, *Statistical Abstract of the United States 1978* (Washington: U.S. Government Printing Office, 1978), p. 788, Table 1370.

TABLE 1

HOUSEHOLDS

(person or group occupying one dwelling)

	TOTAL NUMBER (000's)		PERCENT CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	4872	55 996	0	0
1965	5000	57 251	2.6	2.2
1966	5126	58 092	5.2	3.7
1967	5262	58 845	8.0	5.0
1968	5394	60 444	10.7	7.9
1969	5514	61 805	13.2	10.3
1970	5646	62 874	15.9	12.2
1971	5779	64 374	18.6	14.9
1972	6108	66 676	25.4	19.0
1973	6266	68 251	28.6	21.8
1974	6493	69 859	33.3	24.8

Sources: Statistics Canada, *Household Facilities and Equipment May 1964* to *1974*, pp. 7–10, T1.
Statistical Abstract of the United States 1970, p. 35, T40, *1973*, p. 40, T51; *1974*, p. 40, T52; *1978*, p. 43, T55.

TABLE 2

AVERAGE POPULATION PER HOUSEHOLD

	TOTAL NUMBER		PERCENT CHANGE OVER 1965	
	CANADA	USA	CANADA	USA
1964	3.89	NA	—	—
1965	3.86	3.31	0	0
1966	3.71	3.30	–3.9	–0.3
1967	3.73	3.28	–3.4	–0.9
1968	3.71	3.23	–3.9	–2.4
1969	3.65	3.19	–5.4	–3.6
1970	3.59	3.17	–7.0	–4.2
1971	3.52	3.11	–8.8	–6.0
1972	3.42	3.06	–11.4	–7.6
1973	3.34	3.01	–13.5	–9.1
1974	3.27	2.97	–15.3	–10.3

Sources: *Statistical Abstract of the United States 1971*, p. 36, T44; *1974*, p. 40, T52; *1975*, p. 40, T51.
(64–202) *Household Facilities and Equipment Survey 1964*, p. 8, T1; *1965*, p. 7, T1; *1966*, p. 7, T1; *1967*, p. 7, T1; *1968*, p. 10, T1, p. 28, TA1; *1969*, p. 8, T1; *1970*, p. 7, T1; *1971*, p. 9, T1; *1972*, p. 9, T1; *1973*, p. 9, T1; *1974*, p. 9, T1.

TABLE 3

NUMBER OF PERSONS PER HOUSEHOLD
(percent distributions)*

	1966 CANADA	1965 USA	1971 CANADA	USA
1 person	11.3	15.0	13.4	17.7
2 persons	23.1	28.1	25.2	29.2
3 persons	16.9	17.9	17.3	17.1
4 persons	17.6	16.1	17.5	15.5
5 persons	12.8	11.0	11.9	10.3
6 persons	7.9	5.8	6.9	5.3
7 persons or more	10.1	6.1	7.5	5.0

* Percents do not sum to one due to rounding.

Sources: *Statistical Abstract of the United States 1974*, p. 42, T55.
1966 Census of Canada: Households and families; Introduction to Volume II (93–601), Vol. II (2–1), p. 9–1, T9;
1971 Census of Canada: Households; Households by Size, (93–702) Vol. II, Part 1, p. 2–1, T2.

TABLE 4

DICHOTOMOUS PERCENT DISTRIBUTION OF PERSONS PER HOUSEHOLD*

	1966 CANADA	1965 USA	1971 CANADA	USA
1 or 2 persons	34.4	43.1	38.6	46.9
3 or more	65.3	58.9	61.1	53.2

* Percents do not sum to one due to rounding.

Sources: See "Number of Persons Per Household" table.

TABLE 5

CROWDED HOUSING*

	CANADA		USA	
	THOUSANDS	PERCENT	THOUSANDS	PERCENT
1960			6113	11.5
1961	751	16.5		
1970			5060	8.0
1971	569	9.4		
PERCENT CHANGE		–43.0		–30.4

* Dwellings in which the number of persons exceeds the number of rooms.

Sources: *Canada Year Book 1973*, p. 610, T14.4.
Social Indicators 1973, p. 210, T 6/11.

FIGURE 1

PERCENT OF CROWDED HOUSING

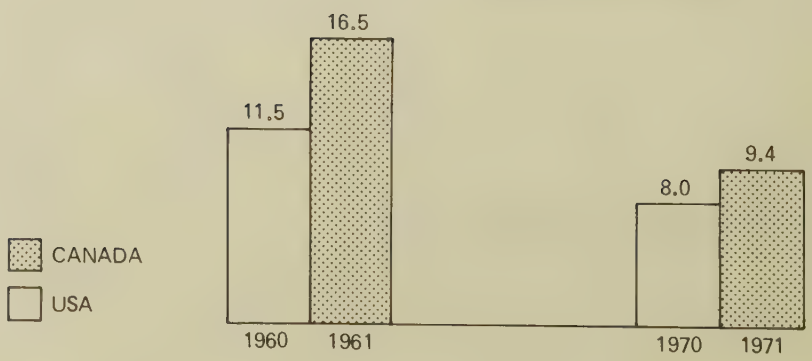

TABLE 6

OCCUPIED HOUSING LACKING SOME OR ALL PLUMBING*

	CANADA		USA	
	THOUSANDS	PERENT	THOUSANDS	PERCENT
1960			9778	16.0
1961	1042	22.9		
1970			4678	5.0
1971	548	9.1		
PERCENT CHANGE		–60.3		–68.8

* Dwelling lacks running water, bath or shower (exclusive use) and/or flush toilet (exclusive use).

Sources: *Statistical Abstract of the United States 1974*, p. 703, T1200; p. 704, T1202. *Canada Year Book 1973*, p. 610, T14.4.

FIGURE 2

PERCENT OF OCCUPIED HOUSING
LACKING SOME OR ALL PLUMBING

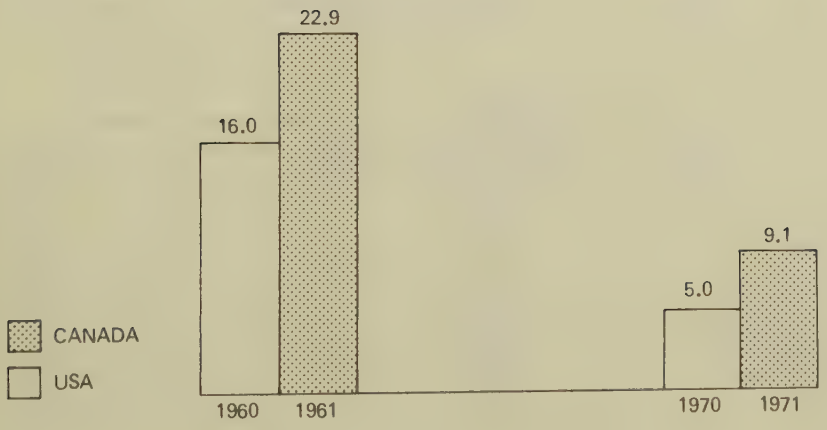

TABLE 7

OCCUPIED HOUSING BY TENURE

	OWNER OCCUPIED				RENTER OCCUPIED			
	CANADA		USA		CANADA		USA	
	THOUSANDS	PERCENT	THOUSANDS	PERCENT	THOUSANDS	PERCENT	THOUSANDS	PERCENT
1960			32 797	61.9			20 228	38.1
1961	3006	66.0			1549	34.0		
1970			39 862	64.2			23 555	35.8
1971	3637	60.3			2398	39.7		
PERCENT CHANGE		–8.6		3.7		16.8		–6.0

Sources: *Statistical Abstract of the United States 1974*, p. 703, T1200; p. 704, T1202. *Canada Year Book 1973*, p. 610, T14.4.

FIGURE 3

PERCENT OF OWNER OCCUPIED HOUSING

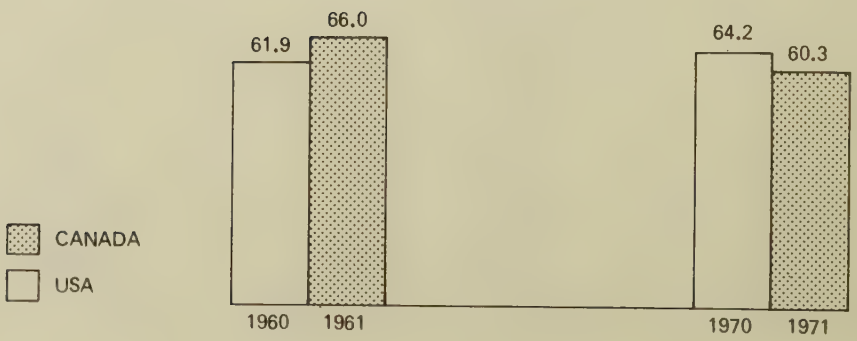

TABLE 8

MEDIAN VALUE OF ONE-FAMILY OWNER-OCCUPIED NON-FARM DWELLINGS

(current dollars)

	CANADA	CANADA IN US DOLLARS	USA
1960			11 900
1961	11 021	10 647	
1970			17 000
1971	19 020	18 833	

	IN CONSTANT 1964 US DOLLARS	
	CANADA	USA
1960		12 371
1961	10 859	
1970		13 505
1971	14 285	
PERCENT CHANGE	31.5	9.1

Sources: *1961 Census of Canada, Housing Values and Rents*, p. 60–1, T60; *1971*, p. 34–1, T34.
Statistical Abstract of the United States 1974, p. 699, T1194.

TABLE 9

PERSONAL EXPENDITURE ON HOUSING*

(millions of current dollars)

	CANADA	CANADA IN US DOLLARS	USA
1964	8171	7575	111600
1965	9743	8110	118900
1966	9493	8811	127400
1967	9845	9126	134800
1968	10647	9880	145300
1969	13400	12443	157300
1970	14408	13800	168400
1971	15578	15425	181500
1972	17247	17411	198100
1973	19769	19765	240900
1974	22878	23395	267100

CONSTANT 1964 US DOLLARS

	MILLIONS		PER CAPITA EXPENDITURE		PER CAPITA EXP. % CHANGE OVER 1964	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	7575	111600	393	582	0	0
1965	7854	115143	400	593	1.8	1.8
1966	8308	120125	415	611	5.6	5.0
1967	8335	123113	408	620	3.9	6.5
1968	8677	127602	418	636	6.4	9.3
1969	10425	131786	495	650	26.0	11.8
1970	10963	133777	513	653	30.5	12.2
1971	11700	137668	542	665	38.1	14.3
1972	12799	145623	586	697	49.2	19.8
1973	13794	168124	624	799	60.0	37.4
1974	14762	168540	658	795	67.5	36.8

* Housing (gross rent), household operations, furniture, equipment and supplies, gas, electricity (fuel and power), domestic service.

Sources: *Statistical Abstract of the United States 1966*, p. 324, T457; *1970*, p. 314, T476; *1974*, p. 376, T605; *1978*, p. 444, T717.
Canada Year Book 1969, p. 1096, T8; *1970–71*, p. 1182, T8, *1972*, p. 1179, T8; *1972*, p. 858, T21.8; *1976–77*, p. 1018, T21.8.

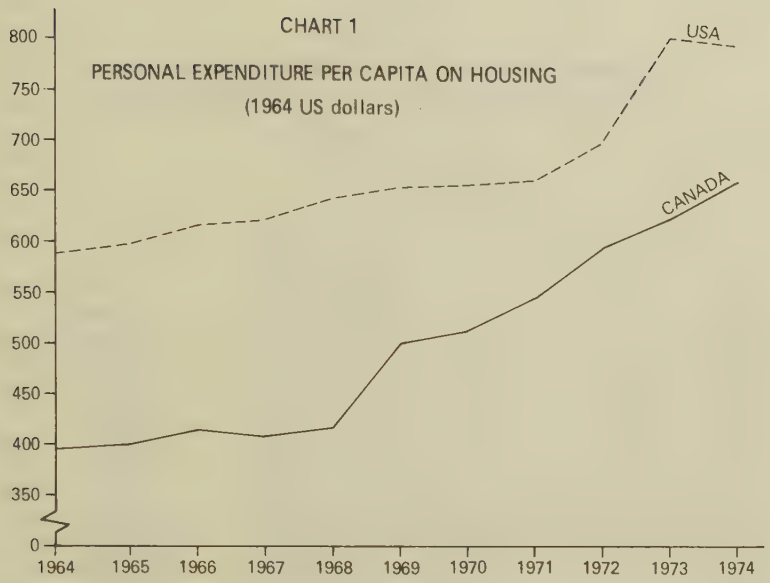

TABLE 10

ON THE WHOLE, WOULD YOU SAY THAT YOU ARE SATISFIED OR DISSATISFIED WITH YOUR HOUSING SITUATION?

	PERCENT SATISFIED	
	CANADA	USA
1963	77	72
1965		71
1966		75
1968	60	
1969		78
1970	86	
1971		74
1973	76	74

Sources: CIPO #305 November 1963; #322 October 1968; #343 September 1970; #362 November 1973;
AIPO #675 July 1963; #715 August 1965; #735 September 1966; #778 April 1969; #842 December 1971; #878 September 1973.

FIGURE 4

ON THE WHOLE, WOULD YOU SAY THAT YOU ARE SATISFIED OR DISSATISFIED WITH YOUR HOUSING SITUATION?

PERCENT SATISFIED

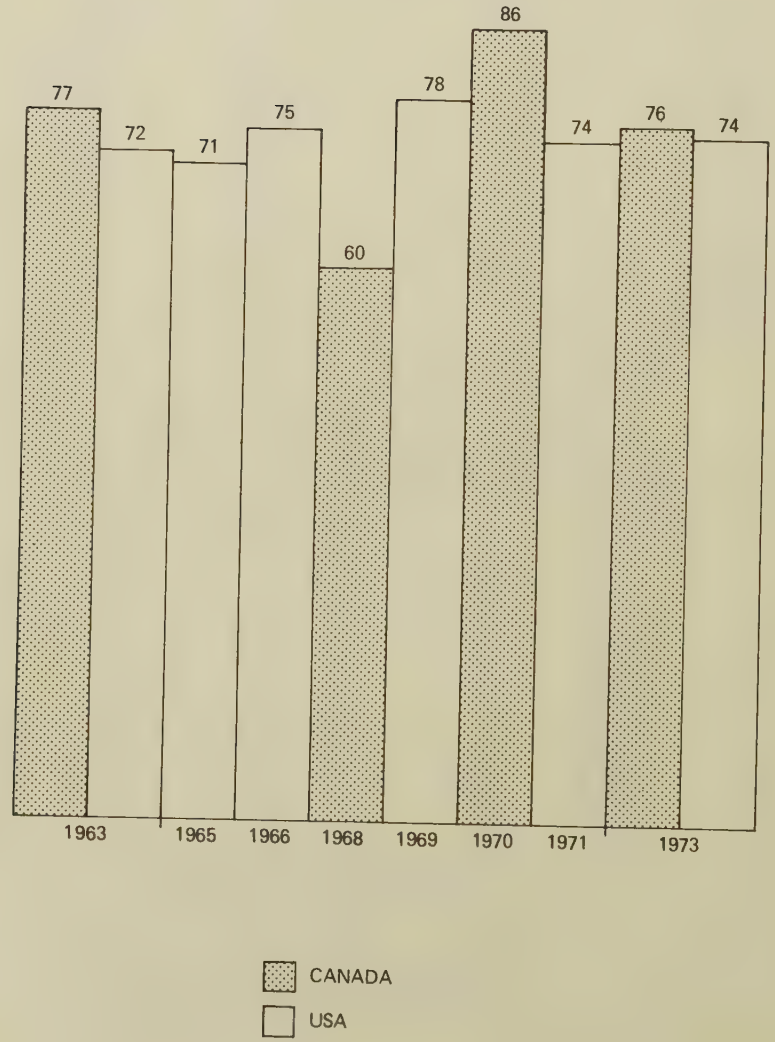

TABLE 11

NEW HOUSING UNITS STARTED

	TOTAL UNITS	
	CANADA	USA (000's)
1964	165 658	1561
1965	166 565	1510
1966	134 474	1196
1967	164 123	1322
1968	196 878	1546
1969	210 415	1500
1970	190 528	1469
1971	233 653	2085
1972	249 914	2379
1973	268 529	2058
1974	222 123	1352

	RATE PER 100 000 HOUSEHOLDS		% CHANGE OVER 1964	
	CANADA	USA	CANADA	USA
1964	3482.4	2787.7	0	0
1965	3432.2	2637.5	–1.4	–5.4
1966	2723.3	2058.8	–21.8	–26.2
1967	3260.3	2246.6	–6.4	–19.4
1968	3650.0	2557.7	4.8	–8.3
1969	3816.0	2427.0	9.6	–12.9
1970	3374.6	2336.4	–3.1	–16.2
1971	4043.1	3238.9	16.1	16.2
1972	4091.6	3568.0	17.5	28.0
1973	4285.5	3015.3	23.1	8.2
1974	3421.0	1935.3	–1.8	–30.6

Sources: *Statistical Abstract of the United States 1974*, p. 695, T1184; *1978*, p. 786, T1366.
Canada Year Book 1972, p. 815, T12; *1973*, p. 609, T14.1, *1976–77*, p. 713, T14.1.

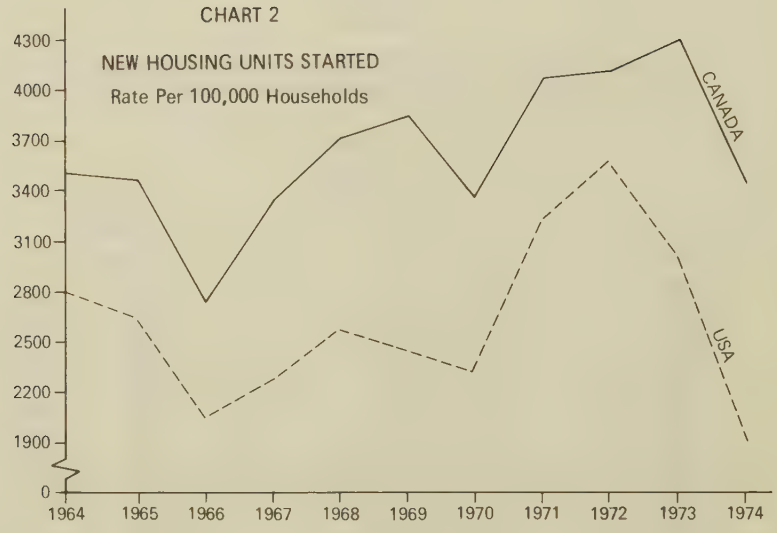

TABLE 12

SINGLE FAMILY DETACHED DWELLING UNIT STARTS

	TOTAL UNITS		AS A PERCENT OF ALL NEW UNITS		PERCENT OF ALL UNITS PERCENT CHANGE OVER 1964	
	CANADA	USA (000's)	CANADA	USA	CANADA	USA
1964	77 079	973	47	62	0	0
1965	75 441	964	45	66	–4.3	6.3
1966	70 642	779	53	67	12.8	8.1
1967	72 534	844	44	65	–6.4	4.8
1968	75 339	900	38	60	–19.2	–3.2
1969	78 404	811	37	55	–21.3	–11.3
1970	70 749	813	37	57	–21.3	–8.1
1971	98 056	1151	42	56	–10.6	–9.7
1972	115 570	1309	46	56	–2.1	–9.7
1973	131 552	1132	49	55	4.3	–11.3
1974	122 143	888	55	66	17.0	6.5

Sources: Central Mortgage and Housing Corporation, *Canadian Housing Statistics 1974* (Ottawa: Minister of Supply and Services, 1975), p. 9, Table 9.
Department of Housing and Urban Development, *1966 Statistical Yearbook*, p. 7, Table 1; *1973*, p. 323, Table 347; *1974*, p. 248, Table 248.

CHART 3

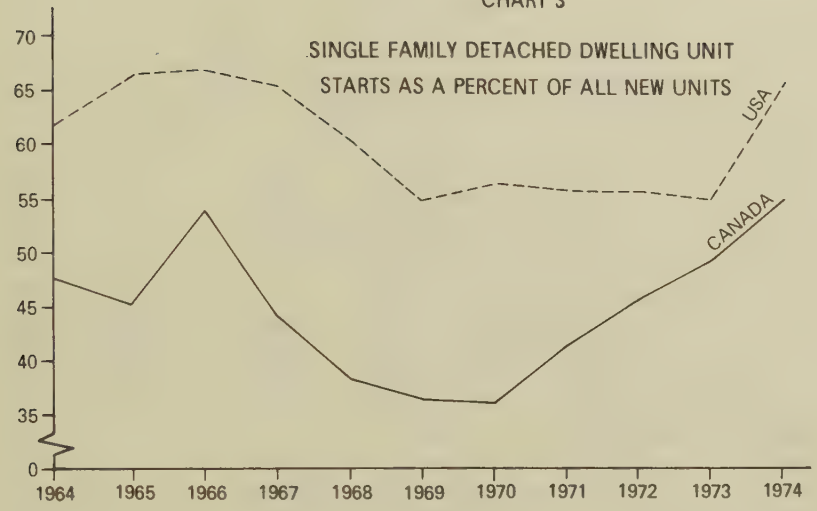

CHART 4

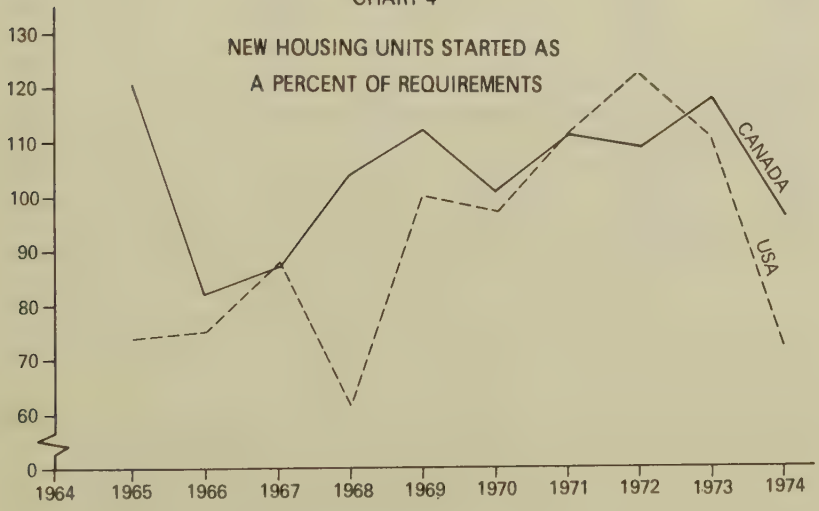

TABLE 13

NEW HOUSING UNITS STARTED,*
AS A PERCENT OF REQUIREMENTS

	UNITS AS A PERCENT OF REQUIREMENTS		PERCENT CHANGE OVER 1965	
	CANADA	USA	CANADA	USA
1965	119.0	74.4	0	0
1966	81.5	74.7	–37.5	0.4
1967	86.4	87.0	–27.4	16.9
1968	103.6	62.4	–12.9	–16.1
1969	110.8	99.8	–6.9	34.1
1970	100.3	97.0	–15.7	30.4
1971	111.3	111.5	–6.5	49.9
1972	108.7	122.8	–8.7	65.1
1973	116.8	111.0	–1.9	49.2
1974	96.6	71.3	–18.8	–4.2

* Mobile homes are excluded.

Sources: U.S. Department of Housing and Urban Development, *1971 HUD Statistical Yearbook*, p. 317, Table 339; *1973*, p. 296, Table 311.
U.S. House of Representatives, Committee on Banking and Currency, *Papers Submitted to the Subcommittee on Housing Panels, Part I*, 92d Cong., 1st Sess., 1971, p. 101, Table 26.
Canadian figures were obtained by dividing annual numbers of new units (T11) by estimated requirements. See text for details.

TABLE 14
BUILDING FIRES*

	TOTAL NUMBER		CURRENT DOLLARS LOSS CANADA IN	
	CANADA	USA[e] (000's)	CANADA (000's)	US DOLLARS USA[e](millions)
1964	75306	912	148377	137560 1362
1965	68432	922	144180	133741 1456
1966	68463	971	162718	151035 1528
1967	65941	961	162371	150518 1623
1968	64657	974	166703	154700 1787
1969	64914	973	197102	183029 1934
1970	67719	992	204194	195577 2209
1971	71729	997	236077	233763 2266
1972	78895	1047	254267	256683 2416
1973	74479	1086	338219	338151 2537
1974	73764	1270	428779	438469 3260

CONSTANT 1964 US DOLLAR LOSS

	THOUSANDS		PER CAPITA LOSS		PER CAPITA LOSS % CHANGE OVER 1964	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	137560	1362000	7.13	7.09	0	0
1965	129515	1409990	6.59	7.25	−7.5	2.2
1966	142411	1440751	7.11	7.33	−0.2	3.3
1967	137468	1482286	6.73	7.45	−5.6	5.0
1968	135858	1569343	6.54	7.81	−8.2	10.1
1969	153342	1620305	7.28	7.99	2.1	12.6
1970	155366	1754830	7.26	8.56	1.8	20.7
1971	177309	1718761	8.22	8.30	15.2	17.0
1972	188688	1776002	8.64	8.50	21.2	19.8
1973	235996	1770572	10.68	8.43	49.8	18.8
1974	276675	2057060	12.33	9.71	72.9	37.0

[e] National Fire Protection Association estimates.

* Includes residential, nonresidential assembly, mercantile, manufacturing, storage, institutional, farm and miscellaneous fires. Excludes forest, grass and other nonbuilding fires.

Sources: *Statistical Abstract of the United States 1968*, p. 468, T679, *1970*, p. 464, T701; *1971*, p. 455, T709; *1974*, p. 472, T773; *1976*, p. 503, T821.
Fire Journal, September issues 1965, 1972 and 1974.
Canada Year Book 1969, p. 1181, T17; *1970–71*, p. 1263, T17; *1972*, p. 1268, T17; *1973*, p. 799, T19.39; *1974*, p. 750, T19.39; *1975*, p. 769, T19.39; *1976–77*, p. 946, T19.31.

CHART 5

PER CAPITA LOSSES FROM BUILDING FIRES
(1964 US dollars)

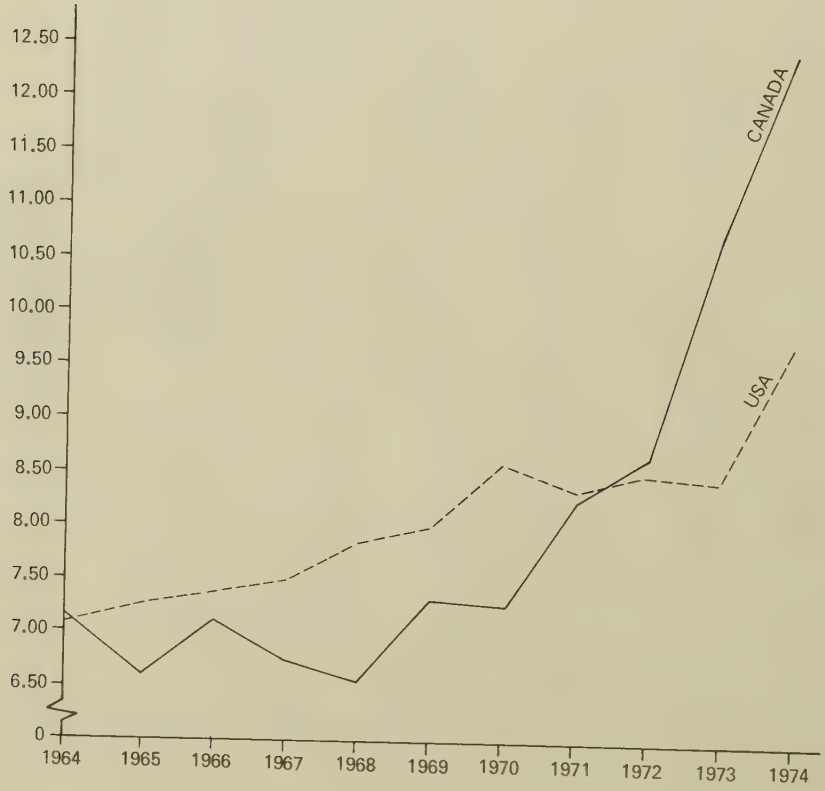

TABLE 15

RESIDENTIAL FIRES*

	NUMBER		CURRENT DOLLAR LOSS (thousands)		
	CANADA	USA[e]	CANADA	CANADA IN US DOLLARS	USA[e]
1964	53 396	642 400	39 674	36 782	454 800
1965	47 619	644 600	46 332	42 978	488 000
1966	47 554	669 400	41 041	38 094	512 000
1967	45 245	665 100	42 013	38 946	562 400
1968	44 117	678 300	45 373	42 106	641 500
1969	44 949	670 700	50 524	46 917	721 300
1970	45 634	690 100	61 014	58 439	841 700
1971	51 133	699 000	76 358	75 610	874 100
1972	50 552	735 600	82 187	82 968	918 400
1973	45 242	795 800	99 557	99 537	1 103 400
1974	43 904	901 000	139 118	142 262	1 302 800

CONSTANT 1964 US DOLLAR LOSS

	THOUSANDS		PER CAPITA LOSS		PER CAPITA LOSS % CHANGE OVER 1964	
	CANADA	USA	CANADA	USA	CANADA	USA
1964	36 782	454 800	1.91	2.37	0	0
1965	41 620	472 579	2.11	2.43	10.4	2.5
1966	35 919	482 765	1.79	2.45	–6.2	3.3
1967	35 569	513 640	1.74	2.58	–8.9	8.8
1968	36 977	563 365	1.78	2.80	–6.8	18.1
1969	39 307	604 305	1.86	2.98	–9.4	25.7
1970	46 424	668 646	2.17	3.26	13.6	37.5
1971	57 350	663 005	2.65	3.20	38.7	35.0
1972	60 990	675 116	2.79	3.23	46.1	36.2
1973	69 467	770 063	3.14	3.66	64.4	54.4
1974	89 767	822 067	4.00	3.88	109.4	63.7

* Includes apartments, one and two-family homes, hotels, motels, boarding houses, cottages, mobile homes and others.

[e] National Fire Protection Association estimates.

Sources: *Canada Year Book 1969*, p. 1181, T17; *1970–71*, p. 1263, T17; *1972*, p. 1268, T17; *1973*, p. 799, T19.39; *1974*, p. 750, T19.36; *1975*, p. 769, T19.39; *1976–77*, p. 949, T19.31.

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Volume Four

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ALEX C. MICHALOS

Social Indicators Research Programme, University of Guelph, Ontario, Canada

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